Repair Manual
Jetta/Beetle 2011 ➤

Generic Scan Tool									
Engine ID	CBF A								

Edition 10.2016

List of Workshop Manual Repair Groups

Repair Group

ST - Generic Scan Tool

Technical information should always be available to the foremen and mechanics, because their careful and constant adherence to the instructions is essential to ensure vehicle road-worthiness and safety. In addition, the normal basic safety precautions for working on motor vehicles must, as a matter of course, be observed.

Contents

ST – Generic Scan Tool

1 General Information

(Edition 10.2016)

Included in the contents of this Generic Scan Tool (GST) manual is a summary table of the vehicle specific OBD II Emission Related DTCs. The DTC table contains DTC Malfunction Criteria, Threshold Values, Secondary Parameters, Enabling Conditions, Monitoring Time Length, Frequency of Checks, and MIL Illumination information which can be used to accurately monitor and diagnose emissions related faults and perform functions required to run Modes 01 through 0A (if applicable) with a hand held scan tool.

This manual also contains the step by step procedures to accurately diagnose and repair a component or system once a DTC has been set. References to repair procedures and wiring diagrams can be found within the diagnostic test procedures.

- ⇒ “1.1 Safety Precautions”, page 2
- ⇒ “1.2 Clean Working Conditions”, page 3

1.1 Safety Precautions

Check for Technical Bulletins that may supersede any information included in this manual.

WARNING

Failure to follow these instructions may result in personal injury or possible death.

Check the Technical Bulletins for information, cautions and warnings that may supersede or supplement any information included in this manual.

When performing the drive cycle operation, pay strict attention to driving conditions and observe and obey all posted speed limits.

Test equipment must always be secured to the rear seat and operated by a second person. If test and measuring equipment is operated from the passenger seat, the person seated could be injured in the event of an accident involving deployment of the passenger-side airbag.

The fuel system is under pressure! Before opening the fuel system, place rags around the connection area. Then release pressure by carefully loosening the connection.

The engine section of the fuel system, after the high pressure pump, is under extremely high pressure! When working on engine or fuel injection system, fuel pressure must be relieved to residual pressure before opening high pressure components. Refer to the Service Manual for the proper procedure.

If the battery has not been disconnected, the fuel pump fuse must be removed before opening the fuel supply system as the fuel pump may be activated by the driver's door contact switch.

Testing of the EVAP and ORVR systems can result in the escape of explosive fuel vapor. Do not smoke while testing the EVAP system, and make sure the area you are working in is well ventilated.

Observe the following for all procedures, especially in the engine compartment due to lack of room:

- *Route lines of all types (e.g. for fuel, hydraulic, EVAP canister system, coolant and refrigerant, brake fluid, vacuum) and electrical wiring so that the original path is followed.*
- *Watch for sufficient clearance to all moving or hot components.*
- *Do not touch or disconnect the Ignition Coils, ignition wires, connecting parts or adapter cables when the ignition is on or the engine is running or turning at starting RPM.*
- *Only disconnect and reconnect wires for injection and ignition system, including test leads, when the ignition is turned off.*

When removing and installing components from full or partially full fuel tanks, observe the following:

- *The fuel tank must only be partially full. How much fuel can remain in the fuel tank may be read in the respective work description. Empty the fuel tank if necessary.*

- *Before starting work, switch on the exhaust extraction system and place an extraction hose close to the installation opening of the fuel tank to extract escaping fuel fumes. If no exhaust extraction system is available, a radial fan (as long as motor is not in air flow) with a displacement greater than 15 m^3/h can be used.*
- *Prevent fuel from contacting the skin. Wear fuel-resistant gloves!*

When servicing the engine control module (ECM), it may be necessary to use a heat gun. The heat gun, shear bolts, and parts of the protective housing will become extremely hot. Use extreme caution when working with or handling these parts to avoid personal injury.

Observe operating instructions when working with a heat gun. To prevent damage (burning) to the wiring and harness connections, insulation and the electronic components, perform outlined work steps exactly!

The cooling system is under pressure. To avoid scalding, use caution when opening the cooling system and servicing cooling system components!

Caution

The battery must only be disconnected and connected with the ignition switched off. Otherwise, the engine control module (ECM) can be damaged.

The use of nails, paper clips, or another unauthorized materials to back-probe electrical harness connectors is strictly prohibited and may cause damage to the electrical harness connectors, terminal ends or to a component. Use only the manufacturers test lead kit or an equivalent aftermarket test lead kit for back-probing all electrical harness connectors.

Do not use sealants containing silicone. Particles of silicone drawn into the engine, will not be burnt in the engine and will damage the oxygen sensors.

Secure all hose connections with the correct hose clips (the same as original equipment).

If engine is to be cranked without starting, for example as part of a compression test, remove the fuses for the voltage supply of Ignition Coils and the fuel injector.

An electrostatic charge can lead to functional problems of electrical components of the engine, transmission and selector lever mechanism. Touch a grounded object, e.g. a water pipe or a hoist, before working on electrical components.

Do not make direct contact with electrical harness connector terminals.

Use only gold-plated terminals when servicing any component with gold-plated electrical harness connector terminals.

1.2 Clean Working Conditions

Even minor contaminations can lead to malfunctions in the fuel injection system. When working on the fuel supply/injection system, pay careful attention to the following rules of cleanliness:

- Thoroughly clean all connections and the surrounding area before disconnecting.

- Place removed parts on a clean surface and cover. Use lint-free cloths.
- Carefully cover opened components or seal, if repairs are not performed immediately.
- When the system is open, do not work with compressed air. Do not move vehicle unless absolutely necessary.
- Install clean components: Remove the parts being replaced immediately prior to installation of the new parts. Do not use parts that have been stored unpacked (e.g. in tool boxes etc.).
- Electrical connectors that have been disconnected: Protect from dirt and moisture. Make sure connections are clean and dry when reconnecting.

2 Description and Operation

2.1 On Board Diagnostic Systems

On Board Diagnostics, or OBD, is an automotive term referring to a vehicle's self-diagnostic and reporting capability. OBD systems give the vehicle owner or repair technician access to the status of the various vehicle sub-systems. Modern OBD implementations use a standardized digital communications port to provide real-time data in addition to a standardized series of Diagnostic Trouble Codes (DTCs) which allow one to rapidly identify and remedy malfunctions within the vehicle. Legislation mandates a vehicle equipped with OBD-II to light up the fault indicator lamp if its emissions exceed the prevailing limit due to system malfunction.

All cars built since January 1st, 1996 (MY 1996) are equipped OBD-II systems. Manufacturers started incorporating OBD-II in various models as early as 1994; however, some early OBD-II cars (MY 1994 and MY 1995) were not 100% compliant.

2.2 Evaporative Emission System

The evaporative emission system has been designed to minimize the release of hydrocarbons from the fuel system into the atmosphere. The evaporative emission system components all work together with the ECM to prevent fuel vapor from escaping and route it to the intake manifold to be burned during normal combustion.

The leak detection system checks the integrity of the evaporative emission system by pressurizing the system.

- There are 3 different types of evaporative emission systems used. These systems are explained below.

2.2.1 Leak Detection Pump (LDP) Evap System

The leak detection pump (LDP) is integrated into the EVAP system and can have two functions. The LDP can:

- Pressurize the EVAP system and detect a drop in pressure that would indicate a leak.
- Function as the EVAP Canister Vent on vehicles that do not have a separate EVAP Canister Vent.

The LDP is a vacuum-driven, ECM controlled, diaphragm pump. In order to operate, the engine must be running and vacuum applied to the Vacuum Switch.

2.2.2 Tank Leak Diagnostic Module (DM - TL) Evap System

The canister purge valve can be actively checked using the Tank Leak Diagnostic Module (DM - TL). For this purpose the electric pump is shortly activated while the combustion engine is running, to build up a minor pressure in the fuel tank and monitor the pressure decay after opening the canister purge valve. Optionally as a quick pass method, the monitoring can be carried out by passively monitoring the fuel mixture deviation when the canister purge valve is opened. If a significant fuel mixture deviation is detected, the purge valve monitor passes. The Tank Leak Diagnostic Module (DM - TL) consists of an electrically operated air pump, an orifice with a defined diameter serving as a reference leak, and a change-over valve switching the air flow between the reference leak and the tank. If neither the pump nor the change-over valve is activated, the tank is ventilated through a bypass in the module.

2.2.3 Natural Vacuum Leak Detection (NVLD) Evap System

The system utilizes an engine-off natural vacuum evaporative system integrity check that tests for leaks with a diameter of 0.020 inch while the engine is off and the ignition is off. The natural vacuum leak detection (NVLD) evaporative system integrity check uses a pressure switch to detect evaporative system leaks. The correlation between the pressure and the temperature in a sealed system is used to generate a vacuum in the tank when the temperature drops. If a sufficient temperature drop is detected for a minimum time period, the vacuum level in a sealed system will exceed the threshold to close the NVLD pressure switch. Therefore, if the switch does not close under these conditions, a leak is detected. If the switch closes, the system is considered to be leak-free.

2.2.4 EVAP System, Checking for Leaks

The following procedure is used to diagnose EVAP System leaks.

Special tools and workshop equipment required

- Smoke tester.
- EVAP and Fuel Supply System Vacuum hose and line routing diagram.

Leak checking

– Using a Smoke tester, check the Evaporative Emission (EVAP) canister system for leaks.

– Always follow the manufacturers directions for the proper installation and operation of the smoke tester being used.

If a leak is detected:

- Check the fuel filler cap seal for damage and for proper installation. Replace if necessary.
- Check all hose connections of the fuel supply system and replace or repair any leaking lines.
- Check all hose connections of the EVAP system and replace or repair any leaking lines.
- Check that the seal under the locking flange is properly tightened on the fuel tank.
- Secure all hose connections using appropriate fittings for the model type.
- Replace seals and gaskets when performing repair work.
- Repair or replace any damaged component.

If no leaks are found in the EVAP system:

- Erase the DTC memory if a DTC was set. Refer to ⇒ “3.3.4 Diagnostic Mode 04 - Erase DTC Memory”, page 21 .
- Perform a road test to verify repair.

If a DTC was set and does not return:

Diagnosis complete. Generate readiness code. Refer to ⇒ “3.2 Readiness Code”, page 14 .

If the same DTC does return and no leaks are found in the EVAP system:

- Check for any related TSB's.
- Perform the diagnostic test procedure for the suspected component.

2.3 Electronic Throttle Control (ETC) System

The electronic throttle control (ETC) system consists of the accelerator-pedal module, the engine control module (ECM), and the electronic throttle body. The electronic throttle body mainly consists of the throttle valve, the electric throttle-valve drive element, and the throttle-valve position sensor (TPS). The drive element is a DC servomotor, which acts on the throttle-valve shaft via a gear unit. The throttle-valve position sensor is a redundant sensor system that detects the position of the throttle valve. The sensors have opposite resistance curves so that the ECM can always cross check the signals to ensure the correct position of the throttle valve is always known.

The driver command is detected by a redundant sensor system in the accelerator-pedal module, and the signal is sent to the engine control module. The engine control module then determines the required throttle-valve position by performing calculations from data measured by sensors such as accelerator pedal position sensor, engine speed sensor and vehicle speed sensor. The actual throttle opening can be more or less in proportion to accelerator pedal position given different engine operating points.

2.4 Electronic Power Control (EPC) Warning Lamp

When the ignition is switched on, the engine control module (ECM) checks the electronic throttle control system for static system integrity (e.g. circuit integrity, communications, etc); the electronic power control (EPC) warning light is turned on via the Instrument Cluster during this process. Shortly after engine start,

the EPC warning light is turned off if no malfunction in the electronic throttle control system is detected. In the event of a malfunction while the engine is running, the ECM will activate the EPC warning light via the Instrument Cluster and at the same time, a Diagnostic Trouble Code (DTC) is stored in the ECM memory.

2.5 Engine Control Module (ECM)

The Engine Control Module (ECM) is a generic term for any embedded system that controls one or more of the electrical systems or subsystems in a vehicle. It controls a series of actuators on an internal combustion engine to ensure that driver commands (e.g. to accelerate) are translated into appropriate engine performance. It reads values from a multitude of sensors, interprets the data, and adjusts the engine actuators accordingly. The ECM also interacts with the transmission control module (TCM), ABS/traction/stability control module and other vehicle function related control systems.

ECM controlled systems and functions (performance and emission related) will be introduced in the following chapters. These include the OBD system, controller area network (CAN), throttle control module, fuel supply, ignition, variable valve timing, exhaust-gas recirculation, secondary air injection, exhaust system, and EVAP system.

2.6 Malfunction Indicator Lamp (MIL)

When the ignition is switched on, the Engine Control Module (ECM) performs checks on static system integrity (e.g. circuit integrity, communications, etc). The Malfunction Indicator Lamp (MIL) is switched on during this process via the Instrument Cluster. After engine starts, the ECM examines engine operation for potential malfunction(s) or failure(s) that can lead to increased emission values. If no malfunction is detected, the ECM switches off the MIL via the Instrument Cluster.

In the event of a malfunction during the operation of the engine, the ECM will activate the MIL via the instrument cluster and at the same time, a Diagnostic Trouble Code (DTC) is stored in the ECM memory. In OBD systems, the MIL can have up to three stages: steady, flashing and Stop Vehicle. A steady MIL indicates a minor fault (e.g. a failing oxygen sensor) whereas a flashing MIL indicates a more severe malfunction that could result in damage of engine or exhaust system components (e.g. the catalytic converter) if left uncorrected for an extended period. This would also indicate a severe fault. The three stages are 1. ON, then OFF; 2. ON steady; 3. flashing constantly. The 3rd stage indicates damage may occur and driver must stop.

2.7 Controller Area Network (CAN)

Overview

The Controller Area Network (CAN) bus is a message-based protocol that allows control units and devices to communicate with each other using a shared network. With this system, control units of the various electronic systems are no longer interconnected by multiple separate cables. This does away with a large number of electrical connections and results in a reduced likelihood of failure of the device network.

Broadcast Communication

Each of the devices on the network has a CAN circuit and is therefore is considered “intelligent”. All devices on the network see all transmitted messages. Each device can determine if a message is relevant or if it should be filtered out. This structure allows modifications to CAN networks with minimal impact. Addi-

tional non-transmitting nodes can be added without modification to the network.

Priority

Every message has an assigned priority. If two nodes try to send messages simultaneously, the one with the higher priority gets transmitted and the one with the lower priority gets postponed. This arbitration does not affect other messages and results in non-interrupted transmission of the highest priority message

2.8 Fuel Supply

Overview

The fuel supply system delivers fuel to an internal combustion engine. With carburetors being replaced by fuel injections systems in the late 1980s and 1990s, the most common types of fuel supply system currently in use are throttle body injection (single-point injection), multiport injection (MPI) and direct injection (DI).

Fuel injectors atomize fuel because high pressure is forcing the fuel through a small nozzle in the injector into the intake air stream or the combustion chamber. This process is often controlled by the ECM and is dependent on data received from other sources (e.g. mass air flow sensor, throttle position sensor, etc.) to determine the precise amount of fuel needed for any given operating condition. The primary advantages of fuel injection over carburetor are improved fuel economy, increased power output and reduced emissions. The following sections will discuss each fuel injection concept in detail.

Throttle Body Injection

Throttle body injection uses a single electrically controlled injector at the throttle body. The fuel is drawn by an electric fuel pump out of the fuel tank and flows through a paper filter into the fuel injector. Since injection happens at the same location as the carburetor, very little engine redesign (intake manifold, fuel line routing, etc.) is necessary. The cost saving of throttle body injection compared to other fuel injection methods encouraged vast adoption in the late 1980s and early 1990s.

Throttle body injection system also inherits many disadvantages of the carburetor. One of them being the inability to precisely control the amount of fuel supplied into each cylinder, and is unable to precisely control combustion and emissions. It also restricts the design of intake manifold as any sharp bends in the intake path will cause atomized fuel to accumulate on the outer wall of the intake path. Supplying moderate engine heat to the intake manifold is also necessary to ensure that the fuel stay vaporized. This results in a relatively high intake air temperature and compromises performance.

Multiport Injection (MPI)

Multiport injection (MPI) consists of an injector for each cylinder just upstream of the intake valve. The fuel pump delivers the fuel into a high-pressure line where it flows to the fuel rail and injectors. When activated by the ECM, each injector sprays fuel at the intake port of its corresponding cylinder – this allows individual cylinders to receive the right amount of fuel in a more precisely timed manner. Sequential fuel injection mode can be applied to activate each injector individually to improve engine response. Lowered fuel consumption and emissions are also achieved.

Sequential multiport injection is still the most common fuel injection system found on most economy cars thanks to its high efficiency, control simplicity and low manufacturing cost (compared to direct injection). However, to further improve drivability (performance) while reducing emissions and fuel consumption, direct injection becomes a superior alternative.

Direct Injection

Injectors in directly injected (DI) engines are mounted on the cylinder head and fuel is injected directly into the engine's combustion chamber. In order to overcome the pressure in the combustion chamber during compression and power stroke, injectors often operate at a primary pressure as high as 3000 psi. At such extreme pressure level, no single fuel pump can supply the required pressure directly from the fuel tank to the injectors. Instead, a low-pressure and a high-pressure system are employed. The low-pressure system principally utilizes the same fuel systems and components for multiport injected engines. The high-pressure system consists of a high-pressure fuel pump driven directly by the camshaft, a fuel rail (high-pressure accumulator), a high-pressure sensor and, depending on the system, a pressure-control valve or a pressure limiter. The injectors are operated by the ECM to send a precise amount of fuel from the high-pressure rail directly into the combustion chamber.

The distinctive difference between direct injection and other injection methods is that direct injection offers the flexibility regarding when in the combustion cycle the fuel is added and how. MPI systems can only add fuel during induction; A DI system can add fuel whenever it needs to. For example, fuel can be added during induction to create a homogeneous charge then added again after ignition to enhance power delivery under full load conditions.

VW/Audi Fuel Stratified Injection (FSI)

The goal of a stratified-charge operation is to form an ignitable mixture near the spark plug at the instant of ignition. This means that, instead of supplying the corresponding stoichiometric fuel quantity to the amount of air in the combustion chamber, the fuel interacts only with a portion of the air before it is conveyed to the spark plug. The rest of the fresh air surrounds the stratified charge allowing an ultra-lean condition with air-fuel ratio exceeding 50:1 in some instances. As less fuel is used to "burn" more air, stratified injection helps to further reduce fuel consumption when the engine is operating in low-load conditions (e.g. highway cruising). This is created by designing the combustion chamber so that a "swirling" effect of the air-fuel charge is caused.

2.9 Ignition and Timing

Ignition

A spark ignition (SI) engine requires a spark to initiate combustion in the combustion chamber. Voltage is supplied to the spark plug where the electricity will arc across a gap at a voltage as high as 100 kilovolts. The ECM determines the precise moment to fire each spark plug using ignition logic which is pre-programmed into the ECM as a function of engine speed and load. An optimally calibrated ignition system ensures consistent and reliable ignition under all conditions. Knock or misfire as a result of incorrect ignition can lead to destruction of engine components or damage of the catalytic converter.

Timing

Shifts in the moment of ignition (ignition timing) can result in increased emissions, decreased performance and fuel economy. Whereas more spark advance improves power and fuel economy, it also raises HC and NOx emissions. Excessive spark advance can cause engine knock which is potentially destructive to engines. If the ECM detects knock from a signal sent by a knock sensor, it will delay (retard) the timing of the spark. Excessive spark retard lowers power output and produces high exhaust temperatures, which can also harm the engine. Carefully designed ignition logic provides optimum timing that best balances performance, fuel economy and emissions.

2.10 Variable Valve Timing

Engines equipped with variable valve timing provide the option of adjusting the phase of the camshaft with respect to the crankshaft. This allows the ECM to control the time at which the valves open or close, and therefore better assists engine “breathing” at various engine speeds. When engine speed increases, the duration of intake and exhaust stroke shortens so that less fresh air can be drawn into the combustion chamber and less exhaust gas can escape. In such a scenario, the ECM opens the intake valve before the exhaust gas has completely left the combustion chamber, and their considerable velocity assists in drawing in the fresh charge – this is referred to as “valve overlap”.

In addition to valve timing, some engines also employ variable valve lift that switches to a more aggressive camshaft-lobe profile as engine speed increases. A more aggressive camshaft-lobe profile actuates valves more rapidly and lifts valves to a greater magnitude in comparison to a normal camshaft-lobe profile. This improves intake and exhaust flow rate, allowing engines to raise maximum operating speed and power output.

2.11 Exhaust-Gas Recirculation (EGR) System

Exhaust-Gas Recirculation (EGR) can be utilized to control the cylinder charge and therefore the combustion process. The exhaust gas that is recirculated to the intake manifold increases the proportion of inert gas in the fresh gas filling; this results in a reduction in the peak combustion temperature and, in turn, a drop in temperature-dependent NOx emission.

Exhaust-gas recirculation is made possible by a connection between the exhaust pipe and the intake manifold. Due to the pressure differential, the intake manifold can draw in exhaust gas via this connection. Together with the exhaust-gas recirculation valve, the ECM adjusts the opening cross-section and therefore controls the partial flow tapped from the main exhaust flow. A malfunction in exhaust-gas recirculation system can result in performance loss and increased emissions. In such a scenario, the Malfunction Indicator Lamp (MIL) lights up and a Diagnostic Trouble Code (DTC) is stored in the ECM memory.

2.12 Secondary Air Injection

Additionally injecting air into the exhaust pipe triggers an exothermic (release of heat) reaction. This leads to the combustion of HC and CO components that prevail mainly during the warm up phase. This oxidation process releases additional heat. Consequently, the exhaust gas becomes hotter, causing the catalytic converter to heat up at a faster rate. For spark-ignition engines, secondary-air injection is an effective means of reducing HC and CO emissions after starting the engine and to rapidly heat up the catalytic converter. This ensures that the conversion of NOx emissions commences earlier.

An electronically controlled valve operates the secondary-air valve (a one-way check valve). The ECM actuates the pump and the control valve, ensuring that secondary air can be injected at a defined point in time. The secondary air must also be injected as close to the outlet valve as possible in order to exploit the high temperatures to utilize the exothermic (release of heat) reaction effectively.

2.13 Exhaust Systems

Overview

There are three important functions of the exhaust system: to reduce the pollutants in exhaust gas, muffle engine combustion noise and to discharge exhaust gas at a convenient location on

the vehicle (often underneath the rear bumper). A passenger-car exhaust system consists of the following; exhaust manifold, exhaust treatment components, sound absorption components and the system of pipes connecting these components.

Exhaust Manifold

The manifold is an important component in the exhaust system. It routes the exhaust gas out of the cylinder outlet ports into the subsequent exhaust system. The geometry of the manifold (i.e. length and cross-section of the individual pipes) has an impact on the performance characteristics, the acoustic behavior of the exhaust system, and the exhaust temperature. In some cases, the manifold is insulated with an air gap to quickly reach high exhaust temperature and to shorten the time taken by the catalytic converter to reach its operating temperature.

Emission Control

The primary emission control component is the catalytic converter, which breaks down the gaseous pollutants in the exhaust gas (CO, HC and NOx). Catalytic converters are installed as close as possible to the engine so that they can quickly reach their operating temperature and therefore be effective in urban driving. It also bears a sound-absorbing function, especially to the higher frequency portion of the engine combustion noise.

Sound Absorption

Mufflers dampen or absorb the noise produced by engine combustion. In principle, they can be installed at any position in the exhaust system. However, they are mostly located in the middle and rear sections of the exhaust system. Depending on the number of cylinders and engine output, generally 1 to 3 mufflers are used in an exhaust system. In V-engines, the left and right cylinder banks are often run separately, each being fitted with its own catalytic converters and mufflers. Although the aim of mufflers is to reduce noise in compliance with legislations, they can also help to create the sound specific to the type of vehicle.

3 Diagnosis and Testing

3.1 Preliminary Check

Note

- *Before performing any pin point test or component diagnosis, a Preliminary Check must be performed.*
- *Check for Technical Bulletins that may supersede any information included in the repair manual or GST Manual.*

- For Electrical Testing: Refer to ⇒ page 13 .
- For Fuel System Mechanical Testing: Refer to ⇒ page 14 .
- For Oxygen Sensor Preliminary Tests: Refer to ⇒ page 14 .

Electrical Testing

Step	Procedure	Result / Action to Take
1	• CONNECT: Scan Tool. • IGNITION: ON. • CHECK: For stored or related DTCs. – Were any other DTCs stored?	– YES: ◆ GO TO: Step 2 ⇒ page 13 . – NO: ◆ GO TO: Step 3 ⇒ page 13 .
2	• Repair these DTCs first before performing any of the following steps.	◆ GO TO: Proper Diagnostic procedure per the stored DTC. Refer to ⇒ “3.4 Engine DTC Tables”, page 34 .
3	• Using the Scan Tool, erase the DTC memory. Refer to ⇒ “3.3.4 Diagnostic Mode 04 - Erase DTC Memory”, page 21 . • Perform a road test to attempt to duplicate the customers complaint. – Does DTC return?	– YES: ◆ GO TO: Step 4 ⇒ page 13 . – NO: ◆ GO TO: Step 5 ⇒ page 13 .
4	• Perform the diagnostic procedure for that DTC.	◆ GO TO: Proper Diagnostic procedure per the stored DTC. Refer to ⇒ “3.4 Engine DTC Tables”, page 34 .
5	• FAULT: Intermittent or a sporadic condition. • CHECK: Suspected components. • PERFORM: Visual Inspection of wiring and components. • CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. • REPAIR: Faulty wiring or connector.	◆ Perform a road test to verify the repair. ◆ Generate readiness code. Refer to ⇒ “3.2 Readiness Code”, page 14 .

Fuel System Mechanical Testing

Check the following items for possible mechanical delivery deficiency:

- Fuel level in tank is too low.
- Fuel lines pinched.
- Fuel filter plugged.
- Fuel pump delivery unit internal leak.
- Clogged injectors.
- Poor fuel quantity delivery. Refer to appropriate repair manual.

Oxygen Sensor Preliminary Tests

Check for the following conditions which can cause Oxygen Sensor Faults to set without requiring Oxygen Sensor replacement:

Common issues for lean faults:

- Vacuum leaks - check for failed or loose vacuum lines, leaking intake gaskets, or any other source of un-metered air leaks (leaks after the Mass Air Flow Sensor).
- Restricted fuel filter or bent/pinched fuel system lines.
- Incorrect input from other sensors, such as the Mass Air Flow Sensor, which may not always set a fault.
- Engine misfire.
- Exhaust leaks.
- Camshaft timing.

Common issues for rich faults:

- Leaking or faulty fuel injector.
- Fuel injector driver shorted in ECM, or wiring short for injectors (short to ground).
- Leaking or faulty fuel pressure regulator or restricted return line.
- Faulty fuel pump or fuel pump driver module.
- Incorrect input from other sensors, such as the Mass Air Flow Sensor, which may not always set a fault.
- Aftermarket components or performance chips.
- Camshaft timing.

3.2 Readiness Code

Caution

When performing the Readiness drive cycle operation, pay strict attention to driving conditions and observe and obey all posted speed limits.

Readiness code description

Diagnostics are performed at regular intervals during normal vehicle operation. After repairing an emissions related system, a readiness code is generated by road testing the vehicle.

If a malfunction is recognized during the drive cycle, it will be stored in the DTC memory.

The OBD drive cycle operation will be monitored with a hand held diagnostic tool. Consult the manufacturer's instruction manual for correct tool operation.

The readiness code is erased every time the DTC memory is erased or any time the battery is disconnected. If the DTC memory has been erased or the battery is disconnected, a new readiness code must be generated.

Only erase the DTC memory if a DTC has been stored.

General recommendations

Most monitors will complete easier and quicker using a "steady-foot" and "smooth" acceleration during the drive cycle operation.

Operating conditions

For the EVAP monitor test, the coolant temperature and the ambient air temperature must be between 10° C and 35° C with a difference between them no greater than 4° C. The ambient air temperature must not change more than 4° C during the drive cycle procedure (e.g. when driving out of a heated workshop in the winter).

Note

Do not assume that the scan tool ID and engine code are correct if the scan tool communicates. The scan tool does not use the ID to establish communication—the units are automatically identified.

Test requirements

- NO DTC in memory.
- Switch OFF all electrical and electronic accessories.
- Necessary driving speed: 50 – 70 mph.
- Drive profile takes approximately 60 – 90 min.

Readiness Drive Cycle Procedure

– CONNECT: Scan Tool.

Step	Procedure	Result / Action to Take
1	Activate Monitors: • START: Engine and idle for 2 – 3 min.	♦ Monitoring Active. ♦ Executes Misfire Monitoring.
2	O2 Sensor Monitoring: • DRIVE: Vehicle at 45 – 55 mph for a continuous 7 minute period. Avoid stopping.	♦ Executes O2 Sensor Monitoring. ♦ Executes Fuel Trim Monitoring. ♦ Executes EVAP Monitoring.
3	Fuel Cut-Off Monitoring: • ACCELERATE: Vehicle to an engine speed of 5,000 RPM; lift off the throttle until the engine speed is around 1,200 RPM.	♦ Fuel Cut-Off Monitoring Ready.

Step	Procedure	Result / Action to Take
4	Catalyst Monitoring: • ACCELERATE: Vehicle smoothly to 60 – 65 mph, cruise at a constant speed for 5 min.	♦ Executes Catalyst Monitoring. ♦ Executes O2 Sensor Monitoring. ♦ Executes Fuel Trim Monitoring. ♦ Executes Misfire Monitoring. ♦ Executes EVAP Monitoring.
5	Secondary Air Injection, EVAP Monitoring: • DRIVE: Vehicle for 30 – 40 min. at a constant speed of 50 – 70 mph in high gear for 2 min with no coasting.	♦ Executes Secondary Air Injection Monitoring. ♦ Executes EVAP Monitoring. • Check the status of the readiness code.

– If any engine monitor fails the drive cycle test. Repeat the drive cycle test until all engine monitors have successfully run through and passed.

Note

- ♦ *When repeating the drive cycle operation for a failed evaporative or thermostat monitor, allow the engine to cool until the coolant temperature and the ambient air temperature are between 10° C and 35° C with a difference between them no greater than 4° C and then repeat the drive cycle operation.*
- ♦ *Depending on the scan tool used, the readiness code status may be displayed as complete, passed or OK. At an ambient air temperature < 7° C, the setting of the readiness for the NOx catalytic converter test is delayed. Here the vehicle must be driven considerably longer.*

Readiness Codes and Monitoring Completed

1 - If any engine monitor fails the drive cycle test, repeat the drive cycle test until all engine monitors have successfully run through and passed.

2 - If the drive cycle operation fails again:

3 - Check the DTC memory for stored DTCs.

4 - Repair the vehicle if necessary.

5 - Repeat the drive cycle operation until all engine monitors have successfully run through and passed.

6 - Remove the scan tool and switch the ignition off.

3.3 Diagnostic Modes 01 - 09

The information provided in Modes 01 through 09 displays the various levels of emission related data that may be monitored, as well as the ability to retrieve and read stored DTC trouble codes, erase stored DTC trouble codes, generate readiness codes, and select the various PIDs and Test-IDs used within the modes to monitor the engine, and emission related component parameters.

Note

Depending on scan tool and protocol used, the information in diagnostic mode 01 may be referred to by different names such as Test-ID (TID), Hex-ID, Component-ID (CID), or On-Board Diagnostic Monitor Identifier (OBDMID).

- ⇒ “3.3.1 Diagnostic Mode 01 - Read Current System Data”, page 17
- ⇒ “3.3.2 Diagnostic Mode 02 - Read Operating Conditions”, page 18
- ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20
- ⇒ “3.3.4 Diagnostic Mode 04 - Erase DTC Memory”, page 21
- ⇒ “3.3.5 Diagnostic Mode 06 - Read Test Results for Specific Diagnostic Functions”, page 22
- ⇒ “3.3.6 Diagnostic Mode 07 - Read Faults Detected During the Current or Last Driving Cycle”, page 32
- ⇒ “3.3.7 Diagnostic Mode 08 - Request Control of On-Board System, Test or Component”, page 33
- ⇒ “3.3.8 Diagnostic Mode 09 - Read Vehicle Information”, page 34

3.3.1 Diagnostic Mode 01 - Read Current System Data

Diagnostic Mode 01 makes it possible to access current emissions-related measured values and diagnostic data. The original measured values (no replacement values), input and output data and system status information are displayed using Diagnostic Mode 1.

Test requirement

- Coolant temperature at least 80 °C.

Procedure

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Diagnostic Mode 1: Obtain data.”.

– From the following table, select the desired the “PID” that is to be monitored, e.g. “PID $05 Coolant temperature”.

The current values of the component or system that is being monitored will be displayed on the scan tool screen.

PID	Component or System
$01:	Monitoring status since erasing DTC memory
$03:	Condition of fuel system
$04:	Calculated load value
$05:	Coolant temperature
$06:	Short term air fuel ratio
$07:	Long term air fuel ratio
$0C:	Engine RPM
$0D:	Vehicle speed

PID	Component or System
$0E:	Ignition timing advance for #1 cylinder
$0F:	Intake air temperature
$10:	Air flow rate from mass air flow sensor
$11:	Absolute throttle position
$12:	Secondary Air Injection
$13:	Oxygen Sensor Bank 1 Sensor 1
$15:	Oxygen Sensor Bank 1 Sensor 2
$16:	Oxygen Sensor Bank 1 Sensor 3
$1C:	OBD Requirements
$1F:	Time since engine start
$21:	Distance driven with MIL ON
$23:	Fuel rail pressure
$2E:	Commanded evap purge
$30:	Warm up counts after MIL erased
$31:	Distance driven after erasing DTC memory
$33:	Barometric pressure
$34:	Heater current Bank 1 Sensor 1
$3C:	Calculated catalyst temperature
$41:	Monitor status current drive cycle
$42:	Control module voltage
$43:	Absolute load value
$44:	Specified value of oxygen sensor signal
$45:	Relative throttle valve position
$46:	Ambient temperature
$47:	Throttle valve position 2 absolute
$49:	Accelerator pedal position 1 absolute
$4A:	Accelerator pedal position 2 absolute
$4C:	Specified throttle valve position
$51	Fuel type
$56:	Offset oxygen sensor regulation after catalytic convertor

– Switch the ignition off.

3.3.2 Diagnostic Mode 02 - Read Operating Conditions

When an emissions-related fault (pending DTC, visible in mode 07) is first detected, operating conditions are stored. Mode 02 makes it possible to access this freeze frame data as soon as this fault is shown in mode 03. Each control module only shows freeze frame data for one fault via mode 02. Therefore, there are two priority levels. If there is a malfunction with higher priority, the freeze frame data is overwritten.

– Fault with higher priority: Misfire malfunction or fuel trim malfunction.

– Fault with normal priority: All other emissions-related faults.

Note

Depending on scan tool and protocol used, the information in diagnostic mode 02 may be referred to by different names such as Test-ID (TID), Hex-ID, Component-ID (CID), or On-Board Diagnostic Monitor Identifier (OBDMID).

Procedure

– Connect the scan tool.

– Start the engine and run at idle.

Note

If the engine does not start, crank the engine using starter for at least 5 seconds, do not switch the ignition off afterward.

– Select “Diagnostic Mode 2: Obtain operating conditions.”.

– From the following table, select the desired the “PID”, e.g. “PID $05 Coolant temperature” that is to be monitored.

The current values of the component or system that is being monitored will be displayed on the scan tool screen.

PID	Component or System
$02:	DTC which triggered Freeze Frame data
$03:	Fuel system status
$04:	Calculated load value
$05:	Coolant temperature
$06:	Short term air-fuel ratio
$07:	Long term air fuel ratio
$0C:	Engine RPM
$0D:	Vehicle speed
$0E:	Ignition timing advance for #1 cylinder
$0F:	Intake air temperature
$10:	Air flow rate from mass air flow sensor
$11:	Throttle valve position 1 absolute
$12:	Secondary Air Injection
$1F:	Time since engine start
$23:	Fuel rail pressure
$2E:	Commanded evap purge
$33:	Barometric pressure
$42:	Control module voltage
$43:	Absolute load value
$44:	Commanded equivalence ratio
$45:	Relative throttle valve position
$46:	Ambient temperature
$47:	Throttle valve position 2 absolute
$49:	Accelerator pedal position 1 absolute
$4A:	Accelerator pedal position 2 absolute
$4C:	Specified throttle valve position
$51	Fuel type

PID	Component or System
$56:	Offset oxygen sensor regulation after catalytic convertor

– Switch the ignition off.

3.3.3 Diagnostic Mode 03 - Read DTC Memory

Diagnostic Mode 03 makes it possible to read emissions-related faults (confirmed DTCs: faults which have activated the MIL) in the ECM and in the TCM.

When the ECM recognizes an emission related fault it turns on the malfunction indicator lamp. If an electronic throttle malfunction is recognized, the ECM turns on the electronic power control warning lamp. Both are located in the instrument cluster.

The DTCs are sorted by SAE code with the DTC tables consisting of a 5 digit alpha numeric value.

Note

Depending on scan tool and protocol used, diagnostic mode 03 and the information provided may be referred to by a different name.

The following tables provide a breakdown and explanation of the DTC code.

P-Codes

Component group					
P	x	x	x	x	DTC for the drivetrain
Norm-Code					
P	0	x	x	x	Trouble codes defined by SAE with specified malfunction texts
P	1	x	x	x	Additional emission relevant DTCs provided by the manufacturer
P	2	x	x	x	DTCs defined by SAE with specified texts, from MY 2000
P	3	x	x	x	Additional emission relevant DTCs provided by the manufacturer from MY 2000

Component group					
Repair group					
P	x	0	x	x	Fuel and air mixture and additional emission regulations
P	x	1	x	x	Fuel and air ratios
P	x	2	x	x	Fuel and air ratios
P	x	3	x	x	Ignition system
P	x	4	x	x	Additional exhaust system
P	x	5	x	x	Speed and idle control
P	x	6	x	x	Control module and output signals
P	x	7	x	x	Transmission
P	x	8	x	x	Transmission
P	x	9	x	x	Control modules, input and output signals

U-Codes

Component group					
U	x	x	x	x	DTC for network (CAN bus)
Norm-Code					
U	0	x	x	x	Trouble codes defined by SAE with specified malfunction texts

Procedure

– Connect the scan tool.

– Switch the ignition to the ON position.

– Select Diagnostic Mode 03: Interrogating fault memory.

– The stored DTC or DTCs will be displayed on the scan tool screen.

The following table is an example of the DTC information that may be displayed on the scan tool screen:

Indication example	Explanation
P0444	SAE Diagnostic Trouble Code
Evaporative emission canister purge regulator valve	Malfunctioning wiring path or malfunctioning component
Circuit open	Malfunction type as next

– Refer to the DTC tables for the diagnostic repair procedures.

– Switch the ignition off.

3.3.4 Diagnostic Mode 04 - Erase DTC Memory

Diagnostic Mode 04 makes it possible to erase the DTC memory and to reset all emissions-related diagnostic data. In that way, all faults in the DTC memory in the ECM and TCM are erased. The adaptation values may also be reset.

Emissions-related diagnostic data includes (as applicable):

- - MIL Status
- - Number of DTCs
- - Readiness bits
- - Confirmed DTCs
- - Pending DTCs
- - DTC that belongs to freeze frame
- - Freeze frame data
- - Test results of specific diagnostic functions
- - Distance driven with “MIL ON”
- - Number of warm-up cycles after erasing the DTC memory
- - Distance driven after erasing the DTC memory
- - Misfire counter

Note

Depending on scan tool and protocol used, diagnostic mode 04 and the information provided may be referred to by a different name.

Procedure

– Connect the scan tool.

– Switch the ignition on.

– Select Diagnostic Mode 03: Interrogating fault memory.

– Then select Mode 4: Reset/delete diagnostic data.

The scan tool will display: Diagnostic data are being erased.

– Switch the ignition off.

3.3.5 Diagnostic Mode 06 - Read Test Results for Specific Diagnostic Functions

Diagnostic Mode 06 makes it possible to retrieve test results for special components and systems which are continuously or not continuously monitored. If the diagnosis of a system is complete, the diagnostic result and the corresponding thresholds are saved and displayed in mode 06. This data remains saved (even with the ignition off) until either new diagnostic results become available or the DTC memory is erased.

The min & max values for each individual test in Mode 06 represent the minimum & maximum operating values for a properly operating system. This data is provided to the individual aftermarket scan tool companies for development of their scan tool. Depending on the scan tool being used, the min & max values shown may vary, or be rounded up or down to the nearest decimal point depending on the aftermarket scan tool company's development process. e.g.:

	Minimum Value
GST manual documentation	0.3499
Aftermarket scan tool display	0.35

Note

Depending on the scan tool and protocol used, the information displayed in diagnostic mode 06 may be referred to by different names such as Test-ID (TID), Hex-ID, Component-ID (CID), or On-Board Diagnostic Monitor Identifier (OBDMID).

Test requirements

- Exhaust system must be properly sealed between the catalytic converter and the cylinder heads.
- No DTCs stored in the DTC memory.
- Coolant temperature at least 80 °C.

Work procedure

– Connect the scan tool.

– Start the engine and let run at idle speed.

– Select Mode 6: Check test the results of components that are not continuously monitored.

Select the desired Test-ID..

The current minimum and maximum values will be displayed on the scan tool screen.

The following table is a numerical list of all“Test-IDs” that may be selected.

Monitor-ID (Hex-ID)	Component or System
$01: ⇒ page 23	Oxygen Sensor Monitor Bank 1 - Sensor 1
$02: ⇒ page 24	Oxygen Sensor Monitor Bank 1 - Sensor 2
$03: ⇒ page 24	Oxygen Sensor Monitor Bank 1 - Sensor 3
$21: ⇒ page 25	Catalytic Converter Monitoring
$35: ⇒ page 26	Camshaft Adjustment / VVT Bank 1
$3A: ⇒ page 26	Fuel Tank EVAP System Integrity/Leak Test (0.90”)
$3B: ⇒ page 26	Fuel Tank EVAP System Integrity/Leak Test (0.40/1.0 mm)
$3C: ⇒ page 27	Fuel Tank EVAP System Integrity/Leak Test (0.20/0.5 mm)
$3D: ⇒ page 27	EVAP Valve Function Check
$41: ⇒ page 28	Oxygen Sensor Heater Monitor Bank 1 - Sensor 1
$42: ⇒ page 29	Oxygen Sensor Heater Monitor Bank 1 - Sensor 2
$43: ⇒ page 29	Oxygen Sensor Heater Monitor Bank 1 - Sensor 3
$71: ⇒ page 30	Secondary Air Injection System
$A2: ⇒ page 30	Mis-Fire Cylinder 1 Data
$A3: ⇒ page 31	Mis-Fire Cylinder 2 Data
$A4: ⇒ page 31	Mis-Fire Cylinder 3 Data
$A5: ⇒ page 31	Mis-Fire Cylinder 4 Data

Monitor-ID $01: Oxygen Sensor Monitor Bank 1 - Sensor 1

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $01”.

– Select the desired “Test-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$83	P0133	Response Check Bank 1 Sensor 1.	0.250 V	1.999 V	Refer to DTC P0133 in the DTC summary table. ⇒ page 47 .
$84	P2195 P2196	Front to rear rationality Bank 1 Sensor 1.	-0.080 V	0.080 V	Refer to DTC P2195 ⇒ page 105 P2196 ⇒ page 105 in the DTC summary table.
$89	P0133	Signal dynamic Bank 1 Sensor 1.	0.250 V	1.999 V	Refer to DTC P0133 in the DTC summary table. ⇒ page 47 .

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Mem-

ory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 .

– Switch the ignition off.

Monitor-ID $02: Oxygen Sensor Monitor Bank 1- Sensor 2

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $02”.

– Select the desired “Test-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$05	P013A	Oxygen Sensor Transient Time rich-lean Bank 1 - Sensor 2	0 s	0.650 s	Refer to DTC P013A in the DTC summary table. ⇒ page 50
$06	P013B	Oxygen Sensor Transient Time lean-rich Bank 1 - Sensor 2	0 s	1.50 s	Refer to DTC P013B in the DTC summary table. ⇒ page 51
$81	P2271	Output Voltage rich during decel.	0 V	0.8018 V	Refer to DTC P2271 in the DTC summary table. ⇒ page 108
$82	P2270	Output Voltage lean during accel.	0.5980 V	1.1306 V	Refer to DTC P2270 in the DTC summary table. ⇒ page 107
$8A	P2271	Deceleration test response time.	0 V	0.1495 V	Refer to DTC P2271 in the DTC summary table. ⇒ page 108
$8C	P013E	Oxygen Sensor Delay Time rich-lean Bank 1 - Sensor 2	0 s	0.650 s	Refer to DTC P013E in the DTC summary table. ⇒ page 53
$8D	P013F	Oxygen Sensor Delay Time lean-rich Bank 1 - Sensor 2	0 s	1.50 s	Refer to DTC P013F in the DTC summary table. ⇒ page 55
$8E	P2270	Oxygen Sensor Maximum Oscillation Voltage	0.75200 V	7.99 V	Refer to DTC P2270 in the DTC summary table. ⇒ page 107
$8F	P2271	Oxygen Sensor Minimum Oscillation Voltage	0 V	0.15100 V	Refer to DTC P2271 in the DTC summary table. ⇒ page 108

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 .

– Switch the ignition off.

Monitor-ID $03: Oxygen Sensor Monitor Bank 1 - Sensor 3

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID $03”.

– Select the desired “Test-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$05	P0145	Deceleration test - HO2S transient time. Bank 1 Sensor 3	0 m/ Sec.	1.200 s	Refer to DTC P0145 in the DTC summary table. ⇒ page 58
$81	P2275	Output Voltage rich during decel.	0 V	0.8018 V	Refer to DTC P2275 in the DTC summary table. ⇒ page 108
$82	P2274	Output Voltage lean during accel.	0.5980 V	1.1306 V	Refer to DTC P2274 in the DTC summary table. ⇒ page 108
$8A	P2275	Deceleration test response time.	0.000 V	0.1495 V	Refer to DTC P2275 in the DTC summary table. ⇒ page 108
$8E	P2274	Maximum Oscillation Bank 1 Sensor 3	0 V	0.1495 V	Refer to DTC P2274 in the DTC summary table. ⇒ page 108
$8F	P2275	Minimum Oscillation Bank 1 Sensor 3	0 V	0.1495 V	Refer to DTC P2275 in the DTC summary table. ⇒ page 108

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 .

– Switch the ignition off.

Monitor-ID $21: Catalytic Converter Monitoring

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID 21”.

– Select the desired “Test-ID” .

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$84	P0420	Catalytic converter monitoring Bank 1.	1.00	19.988	Refer to DTC P0420 in the DTC summary table. ⇒ page 78 .

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 .

– Switch the ignition off.

Monitor-ID $35: Camshaft Adjustment / I V V T Bank 1

– Connect the scan tool.
– Start the engine and run at idle.
– Select “Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID 21”.

– Select the desired “Test-ID”.
– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$80	P0011	V V T specified position not reached.	-32° KW	28° KW	Refer to DTC P0011 in the DTC summary table. ⇒ page 35
$81	P000A	V V T specified position is reached too slow.	-32° KW	28° KW	Refer to DTC P000A in the DTC summary table. ⇒ page 35

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 .
– Switch the ignition off.

Monitor-ID $3A: Fuel Tank EVAP System Integrity/Leak Test (0.90")

– Connect the scan tool.
– Start the engine and run at idle.
– Select “Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID 3A”.

– Select the desired “Test-ID”.
– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$81	P0455	Tank leak test: Large leak.	950 s	65.535 Sec	Refer to DTC P0455 in the DTC summary table. ⇒ page 81 .

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 .
– Switch the ignition off.

Monitor-ID $3B: Fuel Tank EVAP System Integrity/Leak Test (0.40/1.0mm)

– Connect the scan tool.
– Start the engine and run at idle.

– Select “Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID 3B”.

– Select the desired “Test-ID” .

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$81	P0442	Fuel Tank Leak Test: Small leak.	1.550 s	65.535 Sec	Refer to DTC P0442 the DTC summary table. ⇒ page 80
$86	P0442	Fuel Tank Leak Test: Small leak.	900 Pa	8191.75 Pa	Refer to DTC P0442 the DTC summary table. ⇒ page 80

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 .

– Switch the ignition off.

Monitor-ID $3C: Fuel Tank EVAP System Integrity/Leak Test (0.20/0.5mm)

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID 3C”.

– Select the desired “Test-ID” .

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$81	P0456	Tank leak test: Pinhole leak (0.5 mm).	4500 mSec.	65535 mSec	Refer to DTC P0456 in the DTC summary table. ⇒ page 82 .
$82	---	Evap system monitor OK by initial Purge Test	12 g	6553.5 g	Pass only.
$84	P0456	Tank leak test: Very small leak	0.00000	0.17000	Refer to DTC P0456 in the DTC summary table. ⇒ page 82 .

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 .

– Switch the ignition off.

Monitor-ID $3D: EVAP Valve Function Check

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID 3D”.

– Select the desired “Test-ID” .

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$80	P0441	Tank vent valve check from % DTEV: Active test Air balance at idle OK, (Normal operation and short test 70).	.350	1.999	Refer to DTC P0441 in the DTC summary table. ⇒ page 79 .
$82	—	Tank vent valve check from % DTEV: Active test, Oxygen sensor regulator deviating in lean direction (can only test OK), (Normal operation and short test 70).	1	65355	Pass only.
$88	—	Purge flow OK by deviation lambda control.	1	65355	Pass only.
$8C	P0441	Purge flow monitor valve open	0.0000 mA	4.200 to 14.000 mA	Refer to DTC P0441 in the DTC summary table. ⇒ page 79 .
$8D	P0441	Purge flow monitor valve closed	0.0000 mA	4.300 to 36.3000 mA	Refer to DTC P0441 in the DTC summary table. ⇒ page 79 .

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 .

– Switch the ignition off.

Monitor-ID $41: Oxygen Sensor Heater Monitor Bank 1 - Sensor 1

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID 41”.

– Select the desired “Test-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$81	P0141	Oxygen sensor heating between catalytic converter, diagnosis, Bank 1 Sensor 2 internal resistance test.	0 Ohms	4.56 k Ohms	Refer to DTC P0141 in the DTC summary table. ⇒ page 57 .
$85	P0135	Oxygen sensor ceramic temp Bank 1 Sensor 1	715 °C	6513.5 °C	Refer to DTC P0135 in the DTC summary table. ⇒ page 48

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic

repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 .

– Switch the ignition off.

Monitor-ID $42: Oxygen Sensor Heater Monitor Bank 1 - Sensor 2

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID 42”.

– Select the desired “Test-ID” .

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$81	P0141	Oxygen sensor heating between catalytic converter, diagnosis, Bank 1 Sensor 2 internal resistance test.	0 Ohms	5.250 k Ohms	Refer to DTC P0141 in the DTC summary table. ⇒ page 57 .

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 .

– Switch the ignition off.

Monitor-ID 43: Oxygen Sensor Heater Monitor Bank 1 - Sensor 3

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID 42”.

– Select the desired “Test-ID”.

– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$81	P0141 P0147	Oxygen sensor heating between catalytic converter, diagnosis, Bank 1 Sensor 2 internal resistance test.	0 kOhms	4.560 kOhms	Refer to DTC P0141 in the DTC summary table. ⇒ page 57 . or DTC P0147 in the DTC summary table. ⇒ page 58

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure
⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 .

– Switch the ignition off.

Monitor-ID $71: Secondary Air Injection System

– Connect the scan tool.
– Start the engine and run at idle.
– Select “Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID 42”.

– Select the desired “Test-ID”.
– Check specified values at idle.

Test-ID	DTC	Component or System	Min.	Max.	Additional Information
$82	P0491	Secondary air injection system function test.	.102 V	1.999 V	Refer to DTC P0491 in the DTC summary table. ⇒ page 83
$85	P0410	Secondary air injection pressure check.	0 kPa	5.000 kPa	Refer to DTC P0410 in the DTC summary table. ⇒ page 76
$8A	P2440	Secondary air injection leak check.	0.00	1.289	Refer to DTC P2440 in the DTC summary table. ⇒ page 117
$8C	P2440	Tightness check Bank 1.	0.00	1.340	Refer to DTC P2440 in the DTC summary table. ⇒ page 117

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 .
– Switch the ignition off.

Monitor-ID $A2: Mis-Fire Cylinder 1 Data

– Connect the scan tool.
– Start the engine and run at idle.
– Select “Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID A2”.

– Select the desired “Test-ID” .
– Check specified values at idle.

Test-ID	DTC	Component or System	Min./Max. Values	Additional Information
$0B	P0301	Misfire cylinder 1, Average value over 10 Driving Cycles.	0 - 65535 (counts)	Refer to DTC P0301 in the DTC summary table. ⇒ page 69 .
$0C	P0301	Misfire cylinder 1, in this Driving Cycle.	0 - 65535 (counts)	Refer to DTC P0301 in the DTC summary table. ⇒ page 69 .

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 .

– Switch the ignition off.

Monitor-ID $A3: Mis-Fire Cylinder 2 Data

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Mode 6 Check test the results of components that are not continuously monitored”.

Select “Monitor-ID A3:”.

– Select the desired “Test-ID” .

– Check specified values at idle.

Test-ID	DTC	Component or System	Min./Max. Values	Additional Information
$0B	P0302	Misfire cylinder 2, Average value over 10 Driving Cycles.	0 - 65535 (counts)	Refer to DTC P0302 in the DTC summary table. ⇒ page 70 .
$0C	P0302	Misfire cylinder 2, in this Driving Cycle.	0 - 65535 (counts)	Refer to DTC P0302 in the DTC summary table. ⇒ page 70 .

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 .

– Switch the ignition off.

Monitor-ID $A4: Mis-Fire Cylinder 3 Data

– Connect the scan tool.

– Start the engine and run at idle.

– Select “Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID A4”.

– Select the desired “Test-ID” .

– Check specified values at idle.

Test-ID	DTC	Component or System	Min./Max. Values	Additional Information
$0B	P0303	Misfire cylinder 3, Average value over 10 Driving Cycles.	0 - 65535 (counts)	Refer to DTC P0303 in the DTC summary table. ⇒ page 71 .
$0C	P0303	Misfire cylinder 3, in this Driving Cycle.	0 - 65535 (counts)	Refer to DTC P0303 in the DTC summary table. ⇒ page 71 .

– If any of components or systems fail to meet the specified values. Refer to Diagnostic “Mode 03: Interrogating Fault Memory” to check for stored DTC's or the corresponding diagnostic repair procedure ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 .

– Switch the ignition off.

Monitor-ID $A5: Mis-Fire Cylinder 4 Data

– Connect the scan tool.

– Start the engine and run at idle.
– Select “Mode 6: Check test the results of components that are not continuously monitored”.

Select “Monitor-ID A5”.

– Select the desired “Test-ID” .
– Check specified values at idle.

Test-ID	DTC	Component or System	Min./Max. Values	Additional Information
$0B	P0304	Misfire cylinder 4, Average value over 10 Driving Cycles.	0 - 65535 (counts)	Refer to DTC P0304 in the DTC summary table. ⇒ page 72 .
$0C	P0304	Misfire cylinder 4, in this Driving Cycle.	0 - 65535 (counts)	Refer to DTC P0304 in the DTC summary table. ⇒ page 72 .

– Switch the ignition off.
– If any of the components or systems fail to meet the specified values, refer to Diagnostic Mode 03: Interrogating Fault Memory to check for stored DTCs or the corresponding diagnostic repair procedure.
– Switch the ignition off.

3.3.6 Diagnostic Mode 07 - Read Faults Detected During the Current or Last Driving Cycle

Mode 07 makes it possible to check emissions-related faults which appeared during the current or last driving cycle (pending DTCs).

A pending DTC is saved the first time a fault is detected (output via Mode 07).

– If the fault is detected again by the end of the following driving cycle, a confirmed DTC is entered (output via Mode 03) and the MIL is activated.
– If this malfunction is not detected again by the end of the following driving cycle, the corresponding pending code will be deleted at the end of the driving cycle.

Note

Depending on scan tool and protocol used, some of the information provided may be referred to by a different name.

Procedure

– Connect the scan tool.
– Start the engine and run at idle.

Note

If the engine does not start, crank the engine using starter for at least 5 seconds. Do not switch the ignition off afterward.

– Select Mode 7: Check test results of components that are continuously monitored.

The number of pending DTCs or 0 malfunctions detected will be displayed on the scan tool screen.

– Refer to the DTC tables for the diagnostic repair procedures.

– Switch the ignition off.

3.3.7 Diagnostic Mode 08 - Request Control of On-Board System, Test or Component

Diagnostic Mode 08 is used to control the operation of an on-board system, test or component. A Mode 8 service can be used to turn on-board system ON or OFF, or to cycle an on-board system, test or component on or off for a specific period of time. The service can also be used to request system status or to report test results.

Test requirements

- No DTCs stored in the DTC memory.
- Intake Air Temperature (IAT) maximum 60° C.
- Coolant temperature 80 – 110° C.
- Throttle valve angle 12.0 – 16.0%.

Function test

Note

If the accelerator pedal is depressed during the test, the test will be aborted.

– Connect the scan tool.

– Start the engine and run at idle for at least 15 minutes.

– Select “Mode 8: Tank Leak Test”.

– Select “Test-ID 01: Tank Leak Test”.

– Check the specified value of the tank leak test at idle.

– The following will be displayed on the scan tool screen:

Tank leak test	Specified value
♦ Test function active. ♦ Test function is being initiated, please wait. ♦ Test off. ♦ Test aborted.	Test OK.

– Switch the ignition off.

If the specified result is obtained:

System OK.

If the specified result is Not obtained:

– Repeat the tank leak test, switch the ignition off and start the engine again and let run for 15 minutes at idle.

– Switch the ignition off.

If the specified result is again Not obtained:

– A leak may be present. Refer to
⇒ “2.2.4 EVAP System, Checking for Leaks”, page 6 ..

3.3.8 Diagnostic Mode 09 - Read Vehicle Information

Diagnostic Mode 09 makes it possible to access vehicle-specific information from the ECM and the TCM (where applicable).

Note

Depending on scan tool and protocol used, Diagnostic Mode 09 and the information provided may be referred to by a different name.

Test requirement

- No DTCs stored in the DTC memory.

Procedure

– Connect the scan tool.

– Switch the ignition on.

– Select Mode 09: Vehicle information.

– Select the desired Test-ID.

– The information requested will be displayed on the scan tool screen.

The following table is a numerical list of all Test-IDs that may be selected.

Test-ID	Diagnostic text
02:	Vehicle identification number e.g.
	♦ A different 17 digit number will be displayed for each vehicle
04:	Calibration identification e.g.
	♦ Engine Control Module (ECM)
	♦ Transmission Control Module (TCM)
06:	CVN (check sum) e.g.
	♦ EC5AE460 the check sum is different for every control module version
	♦ 000D105

Service $0A	Request Emission Related DTC's with Permanent Status - SUPPORTED

– Switch the ignition off.

3.4 Engine DTC Tables

♦ ⇒ “3.4.1 Engine Control Module ”, page 35

3.4.1 Engine Control Module

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P000A	Intake Camshaft Position Slow Response	• Signal change > 8° CRK for > 2.9 s and adjustment angle < 2.5° CRK	• Time after engine start > 3.0 s • Frequency 4 times • Frequency at cold start 2 times	• 14.0 s	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.2 Camshaft Adjustment Valve 1 N205 , Checking”, page 155 .
P0010	Intake Camshaft Position Actuator Circuit Open Bank 1	• Signal voltage > 4.7 – 5.4 V	• Camshaft valve off • Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.2 Camshaft Adjustment Valve 1 N205 , Checking”, page 155 .
P0011	Intake Camshaft Position Timing - Over-Advanced	• Signal change > 8° CRK for > 2.9 s and adjustment angle < 2.5° CRK	• Time after engine start > 3.0 s • Oil temperature -48 – 143.30° C • Frequency 4 times • Engine speed 600 – 6,000 RPM	• 14.0 s	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.2 Camshaft Adjustment Valve 1 N205 , Checking”, page 155 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0016	Crankshaft Position – Camshaft Position Correlation	• Permissible deviation < -11° CRK OR • Permissible deviation > 11° CRK		• 20 rev • Multiple	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.2 Camshaft Adjustment Valve 1 N205 , Checking”, page 155 . – Check the Engine Speed Sensor - G28- . Refer to ⇒ “3.6.10 Engine Speed Sensor G28 , Checking”, page 171
P0030	HO2S Heater Control Circuit Bank 1 Sensor 1	• Heater voltage 4.70 – 5.40 V	• Time after engine start > 5.0 s • Heater commanded off	• 0.5 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .
P0031	HO2S Heater Control Circuit Low Bank 1 Sensor 1	• Heater voltage < 0 – 3.26 V	• Time after engine start > 5.0 s • Heater commanded off	• 0.5 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0032	HO2S Heater Control Circuit High Bank 1 Sensor 1	• Signal current > 5.50 A	• Time after engine start > 5.0 s • Heater commanded on	• 0.5 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .
P0036	HO2S Heater Control Circuit Bank 1 Sensor 2	• Heater voltage, 4.50 – 5.50 V	• Time after engine start > 5.0 s • Heater, Commanded off	• 0.5 s	• 2 DCY	– Check the Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 .
P0037	HO2S Heater Control Circuit Low Bank 1 Sensor 2	• Heater voltage < 3.0 V	• Time after engine start > 5.0 s • Heater, Commanded off	• 0.5 s	• 2 DCY	– Check the Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 .
P0038	HO2S Heater Control Circuit High Bank 1 Sensor 2	• Heater current, > 2.70 – 5.50 A	• Time after engine start > 5.0 s • Heater, Commanded on	• 0.5 s	• 2 DCY	– Check the Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0042	HO2S Heater Control Circuit Bank 1 Sensor 3	• Heater voltage 2.34 – 3.59 V	• Engine speed > 80 RPM • Heater commanded off	• 0.5 s	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.24 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 197 .
P0043	HO2S Heater Control Circuit Low Bank 1 Sensor 3	• Heater voltage < 2.34 V	• Engine speed > 80 RPM • Heater commanded off	• 0.5 s	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.24 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 197 .
P0044	HO2S Heater Control Circuit High Bank 1 Sensor 3	• Heater voltage > 3.59 V	• Engine speed > 80 RPM • Heater commanded on	• 0.5 s	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.24 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 197 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0068	MAF vs Throttle Position Correlation	• Plausibility with fuel system • Load calculation < -22% • Plausibility with fuel system • Load calculation > 22%	• Engine speed 1,280 – 6,000 RPM • ECT > 63° C • IAT < 90° C • Mass air flow 0 – 300 kg/h • Engine load 20 – 100% • EVAP purge valve closed • Fuel system monitor running • Lambda control closed loop	• 139.4 s	• 2 DCY	– Check the Mass Air Flow Sensor - G70- . Refer to ⇒ “3.6.22 Mass Airflow Sensor G70 , Checking”, page 193 . – Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 213 .
P0070	Ambient Air Temperature Sensor Circuit	• Ambient air temperature < -50° C	• CAN active	• 6.0 s	• 2 DCY	– Check the Mass Airflow Sensor - G70- . Refer to ⇒ “3.6.22 Mass Airflow Sensor G70 , Checking”, page 193 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0071	Ambient Air Temperature Sensor Range/Performance	• Difference in value between ECT and AAT at engine start (depending on engine off time) > 25 K • and • Difference in value between AAT and IAT at engine start (depending on engine off time) > 25 K	• Engine off time > 5.0 h • ECT @ engine start < 2 K • Minus • AAT @ engine start <= 3 K • Vehicle speed > 40 km/h • Minus • ECT @ time after engine start 60.0 s • AAT @ engine start < 5.2° C • Minus • AAT @ condition veh speed > 25 mph for time > 30.0 s • IAT @ engine start < 5.2° C • Minus • IAT @ condition veh speed > 25 mph for time > 30.0 s	• 0.0 s	• 2 DCY	– Check the Mass Airflow Sensor - G70- . Refer to ⇒ “3.6.22 Mass Airflow Sensor G70 , Checking”, page 193 .
P0072	Ambient Air Temperature Sensor Circuit Low	• Ambient air temperature > 77° C	• CAN active	• 6.0 s	• 2 DCY	– Check the Mass Airflow Sensor - G70- . Refer to ⇒ “3.6.22 Mass Airflow Sensor G70 , Checking”, page 193 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0087	Fuel Rail/ System Pressure - Too Low	• Fuel trim activity 0.90 – 1.15 [-] • Pressure controller activity > 2 MPa • Difference between target and actual pressure > -16.4	• Engine speed > 600 RPM • EVAP purge adaptation < 22 [-] • ECT >= 63° C • IAT < 90° C • Lambda control closed loop	• 5.0 s	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ "3.6.15 Fuel Pressure Sensor G247 , Checking", page 180 . – Check the fuel pressure and delivery quantity. Refer to fuel system mechanical testing in ⇒ "3.1 Preliminary Check", page 13 and/ or to appropriate repair manual.
P0100	Mass Air Flow Circuit Fault	• MAF sensor signal 0 µs	• Engine speed > 20 RPM	• 0.2 s	• 2 DCY	– Check the Mass Air Flow Sensor - G70- . Refer to ⇒ "3.6.22 Mass Airflow Sensor G70 , Checking", page 193 .
P0101	Mass Air Flow Circuit Range/Performance	• Mass air flow vs. upper threshold model > 60 – 800 kg/h • Lower threshold model < 0 – 400 kg/h • Load calculation > 18% • Fuel system < -18%	• Time after engine start, 150 camshaft revolutions • Throttle position < 99.6% • Engine speed 1,280 – 6,000 RPM • ECT > 63° C • IAT < 90° C • Mass air flow 0 – 450 kg/h • Engine load 20 – 100% • Lambda control closed loop • EVAP purge valve closed • No low fuel signal	• 2.0 s	• 2 DCY	– Check the Mass Air Flow Sensor - G70- . Refer to ⇒ "3.6.22 Mass Airflow Sensor G70 , Checking", page 193 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0102	Mass Air Flow Circuit Low Input	• MAF sensor signal < 66 µs	• Engine speed > 20 RPM	• 0.2 s	• 2 DCY	– Check the Mass Air Flow Sensor - G70- . Refer to ⇒ “3.6.22 Mass Airflow Sensor G70 , Checking”, page 193 .
P0103	Mass Air Flow Circuit High Input	• MAF sensor signal > 4500 µs	• Engine speed > 20 RPM	• 0.2 s	• 2 DCY	– Check the Mass Air Flow Sensor - G70- . Refer to ⇒ “3.6.22 Mass Airflow Sensor G70 Checking”, page 193 .
P0106	Manifold Absolute Pressure/ Barometric Pressure Circuit Range/Performance	• Difference of boost pressure signal vs altitude sensor signal > 230 hPa • Or • Difference of boost pressure signal vs altitude sensor signal < -130 hPa	• Engine speed < 1,000 RPM • Throttle position < 11.50%	• 2.0 s	• 2 DCY	– Check the Charge Air Pressure Sensor - G31- . Refer to ⇒ “3.6.6 Charge Air Pressure Sensor G31 , Checking”, page 163 . – If there is no fault found with the Charge Air Pressure sensor or wiring, check for any related TSB's. The Altitude (Baro) sensor is located within the ECM and will require replacement of the ECM if faulty. Check the Baro reading with a scan tool vs. actual Baro for the area. If Baro is off by more than 10%, replace the ECM. Refer to appropriate repair manual.

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0111	Intake Air Temperature Sensor 1 Circuit Range/Performance	• Difference in value IAT - ECT @ engine start (depending on engine off time) > 25° C • Difference in value IAT - AAT @ engine start > 25° C (depending on engine off time)	• Engine off time > 5.0 h • ECT @ engine start < 2 K • Minus • AAT @ engine start <= 3 K • Vehicle speed > 40 km/h • Minus • ECT @ time after engine start 60.0 s • AAT @ engine start < 5.2° C	• 0.0 s	• 2 DCY	– Check the Intake Air Temperature Sensor - G42- . Refer to ⇒ “3.6.17 Intake Air Temperature Sensor G42 , Checking”, page 184 .
P0112	Intake Air Temperature Sensor 1 Circuit Low Input	• IAT > 141.0° C		• 2.0 s	• 2 DCY	– Check the Intake Air Temperature Sensor - G42- . Refer to ⇒ “3.6.17 Intake Air Temperature Sensor G42 , Checking”, page 184 .
P0113	Intake Air Temperature Sensor 1 Circuit High Input	• IAT < -46° C		• 2.0 s	• 2 DCY	– Check the Intake Air Temperature Sensor - G42- . Refer to ⇒ “3.6.17 Intake Air Temperature Sensor G42 , Checking”, page 184 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0116	Engine Coolant Temperature Sensor 1 Circuit Range/Performance	• No change on signal < 2 K • Or • Signal in range > 89° C with no change on signal 1.5 K	• ECT @ start 50 - 140 °C (stuck hi) or 50.30 - 88.4 °C (stuck low) • V • Temp 2: • Substitute ECT > -48° C • Mass air flow 28 to 84 kg/h • Driving conditions • Veh speed 0 – 20 km/h • Mass air flow 12 – 36 and 36 – 152 kg/h • Time required > 40.0 s	• 72.0 s	• 2 DCY	– Check the Engine Coolant Temperature Sensor - G62- . Refer to ⇒ “3.6.8 Engine Coolant Temperature Sensor G62 , Checking”, page 167 .
P0117	Engine Coolant Temperature Sensor 1 Circuit Low Input	• ECT >140° C		• 2.0 s	• 2 DCY	– Check the Engine Coolant Temperature Sensor - G62- . Refer to ⇒ “3.6.8 Engine Coolant Temperature Sensor G62 , Checking”, page 167 . – Check the coolant thermostat. Refer to appropriate repair manual.
P0118	Engine Coolant Temperature Sensor 1 Circuit High Input	• ECT < -40° C		• 2.0 s	• 2 DCY	– Check the Engine Coolant Temperature Sensor - G62- . Refer to ⇒ “3.6.8 Engine Coolant Temperature Sensor G62 , Checking”, page 167 . – Check the coolant thermostat. Refer to appropriate repair manual.

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0121	Accelerator Pedal Position Sensor / Accelerator Pedal Position Sensor 2 Circuit Range/Performance	• TPS 1 – TPS 2 > 6.30% • Actual TPS 1 calculated value > TPS 2 calculated value • TPS 1 calc. value > 9.0%	• Engine speed > 480 RPM	• 0.3 s	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 213 .
P0122	Accelerator Pedal Position Sensor / Accelerator Pedal Position Sensor 2 Circuit Low Input	• Signal voltage < 0.20 V		• 0.1 s	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 213 .
P0123	Accelerator Pedal Position Sensor / Accelerator Pedal Position Sensor 2 Circuit High Input	• Signal voltage > 4.81 V		• 0.1 s	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 213 .
P0130	HO2S Circuit Bank 1 Sensor 1	• O2S ceramic temp. < 640° C	• Modeled exhaust temp > 300° C • Fuel cutoff not active	• 12.0 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0131	HO2S Circuit, Bank 1 Sensor 1 Low Voltage	• VM > 1.75 V • UN > 1.50 V • IA or IP > 0.30 V		• 10.0 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .
P0132	HO2S Circuit, Bank 1 Sensor 1 High Voltage	• VM > 3.25 V • UN > 4.40 V • IA or IP > 7.0 V		• 10.0 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0133	HO2S Circuit Slow Response Bank 1 Sensor 1	• Signal dynamic slope check • O2S signal front vs. modeled O2S signal ratio < 0.35 and > 0.01 • Lower value of both counters for area ratios L to R and R to L >= 5 times • Oscillation check • Lambda amplitude signal > 20% • Cycles > 8 • Time lambda > lambda amplitude 400.0 ms • Delay check • Delay modeled lambda signal minus measured signal > 460.0 ms • Cycles > 12	• Engine speed 1,200 – 2,800 RPM • Engine load, 18 – 80% • Delta engine load <= 7.99% • Actual lambda, 0.85 – 1.15 • Lambda control closed loop • EVAP purge flow < 18 [-] • Determination of max and min slope ratios 0.01 – 4 • O2S front - time since operation readiness > 36.0 s • O2S ceramic temp > 715° C • Determination of measurement window, 500.0 ms • Oscillation and delay check • Lambda control, Closed loop • Engine load 20 – 80% • Engine speed 1,340 – 3,500 RPM • Delta engine load < 3% • Actual lambda 0.75 – 1.25 [-]	• 96.0 s • Oscillation and delay check • 200.0 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0135	HO2S Heater Circuit Bank 1 Sensor 1	• Heater duty cycle, > 100% • O2S ceramic temperature, < 715° C • Time after O2S heater on 40.0 s	• Heater control, Active • Modeled exhaust gas temp, > 300° C • ECT at start > -11° C • Engine shutoff time > 300.0 s	• 40.0 – 55.0 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .
P0136	HO2S Circuit Bank 1 Sensor 2 Malfunction	• Delta voltage one step at heater switching > 2.0 V • Number of checks >= 4	• Sensor voltage <= 0.40 V or 0.50 – 1.08 V	• 40.0 s	• 2 DCY	– Check the Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 .
P0137	HO2S Circuit Low Voltage Bank 1 Sensor 2	• Cold condition • Signal voltage, < 0.06 V for 3.0 s • Warm condition • Signal voltage < 0.01 V • Reaction at closed loop enrichment – no reaction	• ECT at engine off, > 60° C • ECT < 39.8° C • Sensor voltage <= 0.40 V or 0.50 – 1.08 V • Warm condition • Sensor sufficient heated if exhaust temperature >= 650° C • Modeled exhaust gas temp. 200.006 – 800.006° C for 60.0 s	• 3.0 s	• 2 DCY	– Check the Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0138	HO2S Circuit High Voltage Bank 1 Sensor 2	• Signal voltage > 1.08 V for > 5.0 s	• Sensor voltage <= 0.40 V • Exhaust gas temp. >= 650° C for 18.0 s	• 5.0 s	• 2 DCY	– Check the Oxygen Sensor 2 Before Catalytic Converter -GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 .
P0139	HO2S Circuit Slow Response Bank 1 Sensor 2	• EWMA filtered transient time at fuel cutoff > 0.0 s • In voltage range of 201 – 401 mV • Number of checks, >= 3	• Rich voltage enable > = 547.9 mV • Lean voltage < = 201.2 mV • Fuel cutoff active • O2S rear ready • Modeled exhaust gas temp > 400° C • Front HO2S sensor lambda signal > 2.0 V	• 100.0 s	• 1 DCY	– Check the Oxygen Sensor 2 Before Catalytic Converter -GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P013A	HO2S Circuit Slow Response Rich to Lean Bank 1 Sensor 3	• EWMA filtered max differential transient time at fuel cutoff >= 0.65 s • Number of checks >= 1	• Time of fuel cut off <= 90.0 s • Time after last fuel cut off >= 20.0 s • Deviation between expected and measured front O2-sensor lambda signal < 6.0 • O2S rear readiness > 10.0 s • Oscillation check completed • After time since fuel cut off at first cylinder >= 0.5 s • Exhaust temperature at sensor > 340° C • Exhaust mass flow > 12.0 kg/h • Exhaust mass flow dynamic within range -250.0 – 150.0 kg/h • Sensor voltage at start of measurement > 0.52 V • Target sensor voltage end of measurement <= 0.18 V • Engine speed 800 – 6,000 RPM	• 10.0 s • Multiple	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.24 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 197 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P013B	HO2S Circuit Slow transient time Lean to Rich Bank 1 Sensor 2	• EWMA filtered max. differential transient time at fuel cutoff >= 1.50 s • Number of checks >= 1.0 [-]	• O2S front out of range = ready, no fault • O2S rear = ready • Engine speed 800 – 6,000 RPM • Integrated exhaust mass since O2S rear ready > 0.04 kg • Exhaust mass flow > 20.0 kg/h • Modeled exhaust temperature fitted position O2S rear >= 340° C • Change of exhaust mass flow -50.0 – 50.0 kg/h • Fuel feed restart = active, if fuel cut off > 90.0 s, then disabling till next fuel feed restart 20.0 s • Additional Conditions: • O2S rear voltage before start of measurement < 0.15 V • O2S rear target voltage end of measurement >= 0.65 V • Or • Integrated negative HO2S mass flow during catalyst purge >= 4,000 mg • Plus time delay 0.0 s • Case 1 (with scavenging): • Integrated air mass = n.a. • Scavenging-rate = n.a • Case 2 (without scavenging): • Integrated air mass > 0 kg	• 10.0 s • Once / DCY	• 1 DCY	– Check the Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
			• Engine running			

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P013E	HO2S Circuit check of delay time Rich to Lean Bank 1 Sensor 2	• Arithmetic filtered max differential delay time at lean to rich transition = n.a. • Or • EWMA filtered max differential delay time at lean to rich transition > 1.0 s • And • Number of checks >= 3.0 [-]	• O2S front out of range = ready, no fault • General: • Heat supply = n.a. • Integrated exhaust mass > 1.0 kg • Integrated exhaust mass flow after O2S rear ready > 0.50 kg • Integrated exhaust mass during > 0.20 kg • Catalyst temperature 400 – 850° C • Exhaust mass flow 40.0 – 180.0 kg/h • Change of exhaust mass flow -65.0 – 65.0 kg/h • Engine speed = 1,320 - 5,00 RPM • O2S rear stuck lean / stuck rich = ready, no fault • Scavenging: • Scavenging-rate = n.a. • Integrated air mass = n.a. • Lambda control = n.a. • Lambda set value = n.a. • For time = n.a • Binary sensor front fitted: • O2S front voltage = n.a. • Linear sensor front fitted: • Lambda value > 1 [-] • Case 1: Diagnosis in Catalyst State full)	• 40.0 s • Once / DCY	• 1 DCY	– Check the Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
			• Time after engine start = n.a. • - Threshold 1 • O2S rear voltage < 0.0 V • Gradient O2S rear voltage -160 V/s • HO2S mass flow >= 50.0 mg • - Threshold 2 • O2S rear voltage < 0.4 V • CASE 2: Diagnosis at Fuel Feed Restart) • Integrated exhaust mass flow n.a • Integrated exhaust mass = n.a. • Exhaust mass during = n.a. • Catalyst temperature = n.a. • Exhaust mass flow = n.a. • Gradient of exhaust mass flow = n.a. • Engine speed = n.a. • O2S rear voltage = n.a. • After fuel cut off = n.a. • For time = n.a. • HO2S mass = n.a.			

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P013F	HO2S Circuit check of delay time Lean to Rich Bank 1 Sensor 2	• Arithmetic filtered max differential delay time at lean to rich transition = n.a. • Or • EWMA filtered max differential delay time at lean to rich transition > 1.5 s • And • Number of checks >= 3.0 [-]	• O2S front out of range = ready, no fault • General: • Heat supply = n.a. • Integrated exhaust mass > 1.0 kg • Integrated exhaust mass flow after O2S rear ready > 0.50 kg • Integrated exhaust mass during > 0.20 kg • Catalyst temperature 400 – 850° C • Exhaust mass flow 40.0 – 180.0 kg/h • Change of exhaust mass flow -65.0 – 65.0 kg/h • Engine speed = 1,320 - 5,000 RPM • O2S rear stuck lean / stuck rich = ready, no fault • Scavenging: • Scavenging-rate = n.a. • Integrated air mass = n.a. • Lambda control = n.a. • Lambda set value = n.a. • For time = n.a. • Binary sensor front fitted : • O2S front voltage = n.a • Linear sensor front fitted: • Lambda value > 1 [-]	• 40.0 s • Once / DCY	• 1 DCY	– Check the Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11”, Checking”, page 203 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
			• Case 1: (Diagnosis in Catalyst State full) • Time after engine start = n.a. • - Threshold 1 • O2S rear voltage < 0 V • Gradient O2S rear voltage -160 V/s • HO2S mass flow >= 50 mg • - Threshold 2 • O2S rear voltage < 0.4 V • Case 2: (Diagnosis at Fuel Feed Restart) • Integrated exhaust mass flow n.a • Integrated exhaust mass = n.a. • Exhaust mass during = n.a. • Catalyst temperature = n.a. • Exhaust mass flow = n.a. • Gradient of exhaust mass flow = n.a. • Engine speed = n.a. • O2S rear voltage = n.a. • After fuel cut off = n.a. • For time = n.a. • HO2S mass = n.a.			

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0140	HO2S Circuit No Activity Detected Bank 1 Sensor 2	• Signal voltage • Signal voltage, 0.40 – 0.60 V for > 3.0 s • Internal resistance • > 40,000 Ω	• Sensor voltage <= 0.40 V or 0.50 – 1.08 V • Sensor threshold • Modeled exhaust gas temp. 700° C for > 10.0 s • Heater power >= 50%	• 38.0 s	• 2 DCY	– Check the Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 .
P0141	HO2S Heater Circuit Bank 1 Sensor 2	• Heater resistance, 702 – 5,250 Ω	• Heater commanded on • Modeled exhaust gas temp, 250 – 650° C • Number of checks 10 • Engine shutoff time > 60.0 s • Fuel cutoff not active	• 15.0 s	• 2 DCY	– Check the Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 .
P0142	HO2S Sensor Circuit Bank 1 Sensor 3	• Delta voltage one step at heater > 2.0 V • Number of checks, 4	• Modeled exhaust gas temp 700° C for > 10.0 s • Dew point exceeded and lower exhaust gas temp limit exceeded for 60.0 s	• 40.0 s	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.24 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 197 .
P0143	HO2S Sensor Circuit Low Voltage Bank 1 Sensor 3	• Cold/Warm condition • Signal voltage < 0.06 V for > 3.0 s	• Cold condition • Sensor voltage <= 0.40 V or 0.50 – 1.08 V • Modeled exhaust gas temp. 700° C for > 10.0 s • Heater power >= 50% for > 10.0 s	• 3.0 s	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.24 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 197 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0144	HO2S Sensor Circuit High Voltage Bank 1 Sensor 3	• Signal voltage > 1.08 V for > 5.0 s	• Cold condition • Sensor voltage <= 0.40 V or 0.50 – 1.08 V • Modeled exhaust gas temp. 700° C for > 10.0 s • Heater power >= 50% for > 10.0 s	• 5.0 s	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.24 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 197 .
P0145	HO2S Sensor Circuit Slow Response Bank 1 Sensor 3	• EWMA filtered transient time at fuel cutoff > 1.2 s • In voltage range of 201.2 – 401.4 mV • Number of checks, 3	• Rich voltage enable > = 548 mV • Lean voltage < = 201.2 mV • Fuel cutoff active • O2S rear ready • Modeled exhaust gas temp > 400° C • Front HO2S sensor lambda signal > 2.0 V	• 100.0 s	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.24 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 197 .
P0146	HO2S Sensor Circuit No Activity Detected Bank 1 Sensor 3	• Signal voltage 0.40 – 0.60 V for > 3.0 s • Internal resistance > 40,000 Ω	• Cold condition • Sensor voltage <= 0.40 V or 0.50 – 1.08 V • Modeled exhaust gas temp. 650° C for > 18.0 s • Heater power >= 50% for > 10.0 s	• 38.0 s	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.24 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 197 .
P0147	HO2S Sensor Heater Circuit Bank 1 Sensor 3	• Heater (ECM internal) resistance 792 – 4,560 Ω	• Modeled exhaust gas temp 250 – 650° C • Engine shutoff time > 60.0 s • Fuel cutoff not active • Number of checks 10 • Heater commanded on	• 15.0 s	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.24 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 197 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0169	Electronic Throttle Control Module function monitoring: injection time	• Comparison with fuel quantity = incorrect • Internal check failed	• Engine speed > 1,200 RPM	• 0.52 – 2.08 s	• 2 DCY	• Check for poor quality fuel or aged fuel in tank. Possible alcohol concentration above 15%. Drain and refill with fresh fuel (with less than 10% alcohol if ethanol fuel is used). • Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 213 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0171	System Too Lean Bank 1	• At idle • Adaptive value > 5.02% • At part load • Adaptive value > 21%	• At idle • Engine speed, 560 – 1,200 RPM • Engine load, 9 – 45% • Mass air flow 5 – 23 kg/h • ECT > 63° C • IAT < 90° C • Part load adaptation ready • Lambda control, Closed loop • EVAP purge valve, Closed • No low fuel signal • At part load • Throttle position < 99.6% • Engine speed 1,320 – 5,000 RPM • Engine load 20 – 100% • Mass air flow 27 – 450 kg/h • ECT > 63° C • IAT < 90° C • Lambda control closed loop • EVAP purge valve closed • No low fuel signal	• 10.0 s	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.15 Fuel Pressure Sensor G247 , Checking”, page 180 . – Check the Fuel Injectors . Refer to ⇒ “3.6.13 Fuel Injectors, Checking”, page 176 . – Check the Oxygen Sensor 1 Before Catalytic Converter GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 . – Check the intake system visually for leaks, or engine gaskets, oil cap loose/ missing that can allow air in the via the PCV system. – Check the vacuum lines visually for leaks.

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0172	System Too Rich Bank 1	• At idle • Adaptive value < -5.02% • At part load • Adaptive value < -21%	• At idle • Engine speed, 560 – 1,200 RPM • Engine load, 9 – 45% • Mass air flow 5 – 23 kg/h • ECT > 63° C • IAT < 90° C • Part load adaptation ready • Lambda control, Closed loop • EVAP purge valve, Closed • No low fuel signal • At part load • Throttle position < 99.6% • Engine speed 1,320 – 5,000 RPM • Engine load 20 – 100% • Mass air flow 27 – 450 kg/h • ECT > 63° C • IAT < 90° C • Lambda control closed loop • EVAP purge valve closed • No low fuel signal	• 10.0 s	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.15 Fuel Pressure Sensor G247 , Checking”, page 180 . – Check the Fuel Injectors . Refer to ⇒ “3.6.13 Fuel Injectors, Checking”, page 176 . – Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 . – Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.11 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 172 .
P0190	Fuel High Pressure Sensor Circuit Open or Short to Battery Voltage	• Signal voltage > 4.8 V		• 0.5 s	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.15 Fuel Pressure Sensor G247 , Checking”, page 180 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0191	Fuel High Pressure Sensor Circuit Range / Performance	• Actual pressure > 20.6 MPa	• Time after engine start > 0.0 s • Engine speed > 90 RPM	• 3.0 s	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ "3.6.15 Fuel Pressure Sensor G247 , Checking", page 180 .
P0192	Fuel High Pressure Sensor Circuit Short to ground	• Signal voltage < 0.2 V		• 0.5 s	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ "3.6.15 Fuel Pressure Sensor G247 , Checking", page 180 .
P0201	Injector Circuit Open Cylinder 1	• Low side signal current < 2.1 A • Internal logic failure	• Engine speed, > 80 RPM • Injection valve switched on	• 0.5 s	• 2 DCY	– Check the Fuel Injectors - N30- . Refer to ⇒ "3.6.13 Fuel Injectors, Checking", page 176 .
P0202	Injector Circuit Open Cylinder 2	• Low side signal current < 2.1 A • Internal logic failure	• Engine speed, > 80 RPM • Injection valve switched on	• 0.5 s	• 2 DCY	– Check the Fuel Injectors - N31- . Refer to ⇒ "3.6.13 Fuel Injectors, Checking", page 176 .
P0203	Injector Circuit Open Cylinder 3	• Low side signal current < 2.1 A • Internal logic failure	• Engine speed, > 80 RPM • Injection valve switched on	• 0.5 s	• 2 DCY	– Check the Fuel Injectors - N32- . Refer to ⇒ "3.6.13 Fuel Injectors, Checking", page 176 .
P0204	Injector Circuit Open Cylinder 4	• Low side signal current < 2.1 A • Internal logic failure	• Engine speed, > 80 RPM • Injection valve switched on	• 0.5 s	• 2 DCY	– Check the Fuel Injectors - N33- . Refer to ⇒ "3.6.13 Fuel Injectors, Checking", page 176 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0221	Accelerator Pedal Position Sensor 1 / Accelerator Pedal Position Sensor 2 Circuit Range/Performance	• TPS 1 – TPS 2 > 6.30% • Actual TPS 2 calculated value > TPS 1 calculated value • TPS 2 – calc. value > 9.00%	• Engine speed > 480 RPM	• 0.3 s	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 213 .
P0222	Accelerator Pedal Position Sensor / Accelerator Pedal Position Sensor 2 Circuit Short to Ground	• Signal voltage < 0.20 V		• 0.1 s	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 213 .
P0223	Accelerator Pedal Position Sensor / Accelerator Pedal Position Sensor 2 Circuit Short to Battery Voltage	• Signal voltage > 4.81 V		• 0.1 s	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 213 .
P0234	Turbocharger Overboost Condition	• Difference of set value boost pressure vs altitude sensor signal > 260 – 1,275 hPa	• Altitude < 2,700 m	• 1.2 s	• 2 DCY	– Check the Charge Air Pressure Sensor - G31- . Refer to ⇒ “3.6.6 Charge Air Pressure Sensor G31 , Checking”, page 163 . – Check the Wastegate Bypass Regulator Valve - N75- . Refer to ⇒ “3.6.34 Wastegate Bypass Regulator Valve N75 , Checking”, page 220 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0236	Turbocharger Boost Sensor Circuit Range/Performance	• Difference of boost pressure signal vs. altitude sensor signal > 230 hPa or < -130 hPa	• Engine speed < 1,000 RPM • Throttle position < 6.81%	• 2.0 s	• 2 DCY	– Check the Charge Air Pressure Sensor - G31- . Refer to ⇒ “3.6.6 Charge Air Pressure Sensor G31 , Checking”, page 163 .
P0237	Turbocharger Boost Sensor Circuit Short to Ground	• Signal voltage < 0.2 V	• Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Charge Air Pressure Sensor - G31- . Refer to ⇒ “3.6.6 Charge Air Pressure Sensor G31 , Checking”, page 163 .
P0238	Turbocharger Boost Sensor Circuit High	• Signal voltage > 4.88 V	• Engine speed > 80 RPM and throttle position < 6.81%	• 0.5 s	• 2 DCY	– Check the Charge Air Pressure Sensor - G31- . Refer to ⇒ “3.6.6 Charge Air Pressure Sensor G31 , Checking”, page 163 .
P0243	Turbocharger Wastegate Solenoid Circuit Open	• Signal voltage > 5.6 – 4.4 V	• Charge (boost) pressure control valve, commanded off • Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Wastegate Bypass Regulator Valve - N75- . Refer to ⇒ “3.6.34 Wastegate Bypass Regulator Valve N75 , Checking”, page 220 .
P0245	Turbocharger Wastegate Solenoid Circuit Short to Ground	• Signal voltage < 3.25 – 2.15 V	• Charge (boost) pressure control valve, commanded off • Engine speed, > 80 RPM	• 0.5 s	• 2 DCY	– Check the Wastegate Bypass Regulator Valve - N75- . Refer to ⇒ “3.6.34 Wastegate Bypass Regulator Valve N75 , Checking”, page 220 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0246	Turbocharger Wastegate Solenoid Circuit Short to Battery Voltage	• Signal current > 2.2 – 4 A	• Charge (boost) pressure control valve, commanded on • Engine speed, > 80 RPM	• 0.5 s	• 2 DCY	– Check the Wastegate Bypass Regulator Valve - N75- . Refer to ⇒ “3.6.34 Wastegate Bypass Regulator Valve N75 , Checking”, page 220 .
P025A	Fuel Pump Module Control Circuit Open	• Signal voltage 4.40 – 5.60 V	• Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Fuel Delivery Unit - GX1- / Fuel Pump Control Module - J538- . Refer to ⇒ “3.6.12 Fuel Delivery Unit GX1 / Fuel Pump Control Module J538 , Checking”, page 174 .
P025C	Fuel Pump Module Control Circuit Low	• Signal voltage 2.15 – 3.25 V	• Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Fuel Delivery Unit - GX1- / Fuel Pump Control Module - J538- . Refer to ⇒ “3.6.12 Fuel Delivery Unit GX1 / Fuel Pump Control Module J538 , Checking”, page 174 .
P025D	Fuel Pump Module Control Circuit High	• Signal current > 1.10 A	• Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Fuel Delivery Unit - GX1- / Fuel Pump Control Module - J538- . Refer to ⇒ “3.6.12 Fuel Delivery Unit GX1 / Fuel Pump Control Module J538 , Checking”, page 174 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0261	Cylinder 1 Injector Circuit Low	• Signal current < 2.1 A	• Injection valve, Commanded on • Engine speed, > 80 RPM • High side signal current, > 4.20 A	• 0.5 s	• 2 DCY • Actual TPS 2 calculated value > TPS 1 calculated value	– Check the Fuel Injectors - N30- . Refer to ⇒ "3.6.13 Fuel Injectors, Checking", page 176 .
P0262	Cylinder 1 Injector Circuit High	• Signal current > 14.70 A	• Injection valve, Commanded on • Engine speed, > 80 RPM	• 0.5 s	• 2 DCY	– Check the Fuel Injectors - N30- . Refer to ⇒ "3.6.13 Fuel Injectors, Checking", page 176 .
P0264	Cylinder 2 Injector Circuit Low	• Signal current < 2.1 A	• Injection valve, Commanded on • Engine speed, > 80 RPM • High side signal current, > 4.20 A	• 0.5 s	• 2 DCY	– Check the Fuel Injectors - N31- . Refer to ⇒ "3.6.13 Fuel Injectors, Checking", page 176 .
P0265	Cylinder 2 Injector Circuit High	• Signal current > 14.70 A	• Injection valve, Commanded on • Engine speed, > 80 RPM	• 0.5 s	• 2 DCY	– Check the Fuel Injectors - N31- . Refer to ⇒ "3.6.13 Fuel Injectors, Checking", page 176 .
P0267	Cylinder 3 Injector Circuit Low	• Signal current < 2.1 A	• Injection valve, Commanded on • Engine speed, > 80 RPM • High side signal current, > 4.20 A	• 0.5 s	• 2 DCY	– Check the Fuel Injectors - N32- . Refer to ⇒ "3.6.13 Fuel Injectors, Checking", page 176 .
P0268	Cylinder 3 Injector Circuit High	• Signal current > 14.70 A	• Injection valve, Commanded on • Engine speed, > 80 RPM	• 0.5 s	• 2 DCY	– Check the Fuel Injectors - N32- . Refer to ⇒ "3.6.13 Fuel Injectors, Checking", page 176 .
P0270	Cylinder 4 Injector Circuit Low	• Signal current < 2.1 A	• Injection valve, Commanded on • Engine speed, > 80 RPM • High side signal current, > 4.20 A	• 0.5 s	• 2 DCY	– Check the Fuel Injectors - N33- . Refer to ⇒ "3.6.13 Fuel Injectors, Checking", page 176 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0271	Cylinder 4 Injector Circuit High	• Signal current > 14.70 A	• Injection valve, Commanded on • Engine speed, > 80 RPM	• 0.5 s	• 2 DCY	– Check the Fuel Injectors - N33- . Refer to ⇒ "3.6.13 Fuel Injectors, Checking", page 176 .
P0299	Turbocharger Underboost	• Difference of set boost pressure vs actual boost pressure value > 150 hPa	• Engine speed > 2,800 RPM • Altitude < 2,700 m • Difference of set value boost pressure vs basic boost pressure value > 250 hPa • Boost pressure control active • Turbo charger bypass valve closed	• 6.0 s	• 2 DCY	– Check the charge air system for proper seal. Refer to appropriate repair manual. – Check the Charge Air Pressure Sensor - G31- . Refer to ⇒ "3.6.6 Charge Air Pressure Sensor G31 , Checking", page 163 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0300	Random Misfire Detected	• Emission threshold 1st interval Misfire Rate (MR), > 2.65% • Catalyst damage misfire rate (MR), > 3 – 20%	• Time from start, 0.0 s • IAT, > -48° C • Time after engine start, Idle +/- 150 RPM and 1 cam rev. • Engine torque, > 5.47 – 23.4% • Camshaft revolutions 1 • Engine speed range, 440 – 6,800 RPM • Fuel cutoff, Not active • ECT at start, > -48° C	• 1,000 Rev • Immediate • 200 Rev • Immediate	• 2 DCY	– Check the spark plugs visually. – Check the intake system visually for leaks. – Check the Fuel Injectors . Refer to ⇒ “3.6.13 Fuel Injectors, Checking”, page 176 . – Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 . – Check the fuel pressure and delivery quantity. Refer to fuel system mechanical testing in ⇒ “3.1 Preliminary Check”, page 13 and/or to appropriate repair manual.

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0301	Cylinder 1 Misfire Detected	• Emission threshold 1st interval Misfire Rate (MR), > 2.65% • Catalyst damage misfire rate (MR), > 3 – 20%	• Time from start, 0.0 s • IAT, > -48° C • Time after engine start, Idle +/- 150 RPM and 1 cam rev. • Engine torque, > 5.47 – 23.4% • Camshaft revolutions 1 • Engine speed range, 440 – 6,800 RPM • Fuel cutoff, Not active • ECT at start, > -48° C	• 1,000 Rev • Immed. • 200 Rev. • Immed.	• 2 DCY	– Check the spark plugs visually. – Check the intake system visually for leaks. – Check the Fuel Injectors . Refer to ⇒ “3.6.13 Fuel Injectors, Checking”, page 176 . – Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 . – Check the fuel pressure and delivery quantity. Refer to fuel system mechanical testing in ⇒ “3.1 Preliminary Check”, page 13 and/or to appropriate repair manual.

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0302	Cylinder 2 Misfire Detected	• Emission threshold 1st interval Misfire Rate (MR), > 2.65% • Catalyst damage misfire rate (MR), > 3 – 20%	• Time from start, 0.0 s • IAT, > -48° C • Time after engine start, Idle +/- 150 RPM and 1 cam rev. • Engine torque, > 5.47 – 23.4% • Camshaft revolutions 1 • Engine speed range, 440 – 6,800 RPM • Fuel cutoff, Not active • ECT at start, > -48° C	• 1,000 Rev • Immed. • 200 Rev • Immed.	• 2 DCY	– Check the spark plugs visually. – Check the intake system visually for leaks. – Check the Fuel Injectors . Refer to ⇒ “3.6.13 Fuel Injectors, Checking”, page 176 . – Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 . – Check the fuel pressure and delivery quantity. Refer to fuel system mechanical testing in ⇒ “3.1 Preliminary Check”, page 13 and/or to appropriate repair manual.

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0303	Cylinder 3 Misfire Detected	• Emission threshold 1st interval Misfire Rate (MR), > 2.65% • Catalyst damage misfire rate (MR), > 3 – 20%	• Time from start, 0.0 s • IAT, > -48° C • Time after engine start, Idle +/- 150 RPM and 1 cam rev. • Engine torque, > 5.47 – 23.4% • Camshaft revolutions 1 • Engine speed range, 440 – 6,800 RPM • Fuel cutoff, Not active • ECT at start, > -48° C	• 1,000 Rev • Immed. • 200 Rev • Immed.	• 2 DCY	– Check the spark plugs visually. – Check the intake system visually for leaks. – Check the Fuel Injectors . Refer to ⇒ “3.6.13 Fuel Injectors, Checking”, page 176 . – Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 . – Check the fuel pressure and delivery quantity. Refer to fuel system mechanical testing in ⇒ “3.1 Preliminary Check”, page 13 and/or to appropriate repair manual.

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0304	Cylinder 4 Misfire Detected	• Emission threshold 1st interval Misfire Rate (MR), > 2.65% • Catalyst damage misfire rate (MR), > 3 – 20%	• Time from start, 0.0 s • IAT, > -48° C • Time after engine start, Idle +/- 150 RPM • Engine torque, > 5.47 – 23.4% • Camshaft revolutions 1 • Engine speed range, 480 – 6,800 RPM • Fuel cutoff, Not active • ECT at start, > -10.50° C	• 1,000 Rev • Immed. • 200 Rev • Immed.	• 2 DCY	– Check the spark plugs visually. – Check the intake system visually for leaks. – Check the Fuel Injectors . Refer to ⇒ “3.6.13 Fuel Injectors, Checking”, page 176 . – Check the Ignition Coils with Power Output Stage . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 . – Check the fuel pressure and delivery quantity. Refer to fuel system mechanical testing in ⇒ “3.1 Preliminary Check”, page 13 and/or to appropriate repair manual.
P0321	Engine Speed Input Circuit Performance	• Comparison of counted teeth vs reference = incorrect • Monitoring reference gap failure		• 1.5 s	• 2 DCY	– Check the Engine Speed Sensor - G28- . Refer to ⇒ “3.6.10 Engine Speed Sensor G28 , Checking”, page 171 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0322	Engine Speed Input Circuit No Signal	• Camshaft signal > 3 • Engine speed, no signal		• 2.5 s	• 2 DCY	– Check the Engine Speed Sensor - G28- . Refer to ⇒ “3.6.10 Engine Speed Sensor G28 , Checking”, page 171 .
P0324	Knock Control System Error	• Signal fault counter (combustion) > 24 • Or • Signal fault counter (measuring window) > 2.00	• Engine speed 2500 RPM	• 0.5 s	• 2 DCY	– Check the Knock Sensor - G61- . Refer to ⇒ “3.6.20 Knock Sensor 1 G61 , Checking”, page 189 .
P0327	Knock Sensor 1 Circuit Low	• Lower threshold < -0.70 V • Or for signal range check • Lower threshold < 0 - 1.60 V	• Engine speed, > 1,000 RPM • or for signal range check • ECT > 41° C • Engine load > 35 – 60% • Engine speed > 2,000 RPM	• 0.5 s	• 2 DCY	– Check the Knock Sensor - G61- . Refer to ⇒ “3.6.20 Knock Sensor 1 G61 , Checking”, page 189 .
P0328	Knock Sensor 1 Circuit High	• Upper threshold > 1.0 V • Or for signal range check • > 15 – 115.87 V	• Engine speed, > 1000 RPM or for signal range check • ECT > 40.5° C • Engine load > 35 - 60% • Engine speed > 2000 RPM	• 0.5 s	• 2 DCY	– Check the Knock Sensor - G61- . Refer to ⇒ “3.6.20 Knock Sensor 1 G61 , Checking”, page 189 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0340	Camshaft Position Sensor Circuit	• Cam adaption values out of range • > 20° KW • < -20° KW • Difference of adapted and actual values > 9° KW	• Engine speed sensor, No DTC • Phase sensor, No DTC • Cam adaptation, Active • Engine speed sensor, No DTC • Phase sensor, No DTC • Camshaft adjustment, No DTC • Engine start, Completed • Cam adaptation, Completed • Camshaft in ref pos. for > 2.0 s	• 2.0 s	• 2 DCY	– Check the Camshaft Position Sensor - G40- . Refer to ⇒ “3.6.3 Camshaft Position Sensor G40 , Checking”, page 157 .
P0341	Camshaft Position Sensor Circuit Performance	• Signal pattern incorrect • Defect counter 12 [-]		• 0.5 s	• 2 DCY	– Check the Camshaft Position Sensor - G40- . Refer to ⇒ “3.6.3 Camshaft Position Sensor G40 , Checking”, page 157 .
P0342	Camshaft Position Sensor Circuit Low	• Signal voltage low • Crankshaft signals = 8 [-]		• 0.5 s	• 2 DCY	– Check the Camshaft Position Sensor - G40- . Refer to ⇒ “3.6.3 Camshaft Position Sensor G40 , Checking”, page 157 .
P0343	Camshaft Position Sensor Circuit High	• Signal voltage high • Crankshaft signals = 8 [-]		• 0.5 s	• 2 DCY	– Check the Camshaft Position Sensor - G40- . Refer to ⇒ “3.6.3 Camshaft Position Sensor G40 , Checking”, page 157 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0351	Ignition Coil A Primary Circuit	• Signal current 0.25 – -2.0 mA • Internal check failed	• Engine speed > 680 RPM	• 2.0 s • Continuous	• 2 DCY	– Check the Ignition Coils with Power Output Stage - N70- . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 .
P0352	Ignition Coil B Primary Circuit	• Signal current 0.25 – -2.0 mA • Internal check failed	• Engine speed > 680 RPM	• 2.0 s • Continuous	• 2 DCY	– Check the Ignition Coils with Power Output Stage - N127- . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 .
P0353	Ignition Coil C Primary Circuit	• Signal current 0.25 – -2.0 mA • Internal check failed	• Engine speed > 680 RPM	• 2.0 s • Continuous	• 2 DCY	– Check the Ignition Coils with Power Output Stage - N291- . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 .
P0354	Ignition Coil D Primary Circuit	• Signal current 0.25 – -2.0 mA • Internal check failed	• Engine speed > 680 RPM	• 2.0 s • Continuous	• 2 DCY	– Check the Ignition Coils with Power Output Stage - N292- . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0410	Secondary Air System rationality check	• Diff. of measured AIR pressure before AIR injection vs. AIR pressure after AIR injection > 5.0 kPa	• ECT 5 – 115° C • IAT @ manifold 5 – 100° C • Modeled catalyst temp. < 700° C • Mass air flow 7.0 – 140.0 kg/h • Delta engine load -7.0 – 7.0 %/rev • Altitude < 2,700 m • AIR System = Commanded Off	• 0.5 s • Once / DCY	• 2 DCY	– Check the Secondary Air Injection Pump Relay - J299- / Secondary Air Injection Pump Motor - V101- . Refer to ⇒ “3.6.27 Secondary Air Injection Pump Relay J299 / Secondary Air Injection Pump Motor V101 , Checking”, page 206 . – Check the Secondary Air Injection Solenoid Valve - N112- . Refer to ⇒ “3.6.29 Secondary Air Injection Solenoid Valve N112 , Checking”, page 210 .
P0413	Secondary Air Injection System, Solenoid Valve Circuit Open	• Signal voltage 4.70 – 5.40 V	• Air valve commanded off • Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Secondary Air Injection Solenoid Valve - N112- . Refer to ⇒ “3.6.29 Secondary Air Injection Solenoid Valve N112 , Checking”, page 210 .
P0414	Secondary Air Injection System Switching Valve Circuit Short to Ground or Short to Battery Voltage	• Signal voltage 0 to 3.25 V • Or • Signal current > 2.20 A	• Air valve commanded off • Engine speed > 80 RPM • Or • Air valve commanded on • Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Secondary Air Injection Solenoid Valve - N112- . Refer to ⇒ “3.6.29 Secondary Air Injection Solenoid Valve N112 , Checking”, page 210 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0418	Secondary Air Injection Pump Relay Open	• Signal voltage 4.70 – 5.40 V	• Pump relay commanded off • Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Secondary Air Injection Pump Relay - J299- / Secondary Air Injection Pump Motor - V101- . Refer to ⇒ “3.6.27 Secondary Air Injection Pump Relay J299 / Secondary Air Injection Pump Motor V101 , Checking”, page 206 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0420	Catalyst System Efficiency Below Threshold	• Front: • Oxygen storage capacity (OSC) vs OSC of borderline catalyst < 1.0 • Front catalyst < 1.50 • Main catalyst < 1.0 • Main: • Oxygen storage capacity (OSC) vs OSC of borderline catalyst < 0.40 • Front catalyst < 0.90 • while value for front catalyst < 2.0	• Front: • Time after engine start > 0.0 s • Delta exhaust mass flow < 23.1 kg/h • Exhaust gas mass flow, lower range 40.0 – 130.0 kg/h • Exhaust gas mass flow upper range 60.0 – 130.0 kg/h • Modeled exhaust gas temp, lower range > 460° C • Modeled exhaust gas temp, upper range 640 – 780° C • Engine speed 1,320 – 3,520 RPM • Number of checks, 4 • O2S front/rear, ready/no faults • SAS, not active • No misfire • Main: • Time after engine start > 80.0 s • Delta exhaust mass flow < 30 kg/h • Exhaust gas mass flow, lower range 25.0 – 80.0 kg/h • Exhaust gas mass flow upper range 60.0 – 160.0 kg/h • Modeled exhaust gas temp, lower range 435 – 660° C • Modeled exhaust gas temp, upper range 530 – 740° C	• 15.0 – 40.0 s • Once / DCY	• 2 DCY	– Check the Three Way Catalytic Converter (TWC). Refer to ⇒ “3.6.30 Three Way Catalytic Converter (TWC), Checking”, page 212 . – Check the Oxygen Sensor 2 Before Catalytic Converter -GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 . – Check the Oxygen Sensor 1 After Catalytic Converter -GX7- . Refer to ⇒ “3.6.24 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 197 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
			• Engine speed 1,200 – 3,520 RPM • Number of checks, 4 • O2S front/rear, ready/no faults • SAS, not active • No misfire			
P0441	Evaporative Emission System Incorrect Purge Flow	• Deviation < 8% lambda controller and 35% idle controller	• Evap purge flow integral 25 – 120 g • Integrated air mass 1.50 – 2.50 kg • Engine speed = idle • Engine speed deviation < 80 RPM • ECT > 65° C or substitute 80° C • IAT > 4° C • Altitude < 2,700 m • Lambda control, closed loop	• 120.0 s • Once / DCY	• 2 DCY	– Check the EVAP system for leaks. Refer to ⇒ “2.2.4 EVAP System, Checking for Leaks”, page 6 . – Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.11 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 172 . – Check the Leak Detection Pump - V144- . Refer to ⇒ “3.6.21 Leak Detection Pump V144 , Checking”, page 191 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0442	Evaporative Emission System Leak Detected Small Leak	• Time for pressure drop < 1.6 – 1.8 s	• Time after engine start 12.0 – 65,530.0 s • ECT 3.8 –120° C • ECT at start 5 – 50 ° C • Engine off time > 21,600.0 s • Ambient air temp 5 – 59° C • Ambient air temp drop after start < 8 K • Intake manifold vac. > -2,560 hPa • Altitude < 2,700 m • Veh. speed >= 0 km/h • Veh speed once > 40 km/h • Any drive gear • Restart temp diff. > 0 K • Purge valve closed • LDP active	• 139.0 s • Once / DCY	• 2 DCY	– Check the EVAP system for leaks. Refer to ⇒ “2.2.4 EVAP System, Checking for Leaks”, page 6 . – Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.11 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 172 . – Check the Leak Detection Pump (LDP) - V144- . Refer to ⇒ “3.6.21 Leak Detection Pump V144 , Checking”, page 191 .
P0444	Evaporative Emission System Purge Control Valve Circuit Open	• Signal voltage > 4.70 – 5.40 V	• EVAP purge valve Commanded Off • Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.11 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 172 .
P0447	Evaporative Emission System Vent Control Circuit Open	• Signal voltage > 4.70 – 5.40 V	• EVAP purge valve Commanded Off	• 0.5 s	• 2 DCY	– Check the Leak Detection Pump - V144- . Refer to ⇒ “3.6.21 Leak Detection Pump V144 , Checking”, page 191 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0448	Evaporative Emission System Vent Control Circuit Shorted to B+ or ground	• Short to B+ - Signal current > 2.2 – 4.0 A • Short to Ground - Signal voltage < 2.74 – 3.26 V	• Short to B+ - EVAP pump solenoid valve commanded ON • Short to ground - EVAP pump commanded Off	• 0.5 s	• 2 DCY	– Check the Leak Detection Pump - V144- . Refer to ⇒ “3.6.21 Leak Detection Pump V144 , Checking”, page 191 .
P0455	Evaporative Emission System Leak Detected Gross Leak/No Flow	• Time for pressure drop < 1.0 s	• Time after engine start 12.0 – 65,530.0 s • ECT 5 – 120° C • ECT at start 5 – 50° C • Engine off time > 21,600.0 s • Ambient air temp 5 – 59° C • Ambient air temp drop after start < 12 K • Intake manifold vac. > -2,560 hPa • Altitude < 2,700 m • Veh. speed >= 0 km/h • Veh speed once > 40 km/h • Any drive gear • Restart temp diff. > 0 K • Purge valve closed • LDP active	• 136.0 s	• 2 DCY	– Check the EVAP system for leaks. Refer to ⇒ “2.2.4 EVAP System, Checking for Leaks”, page 6 . – Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.11 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 172 . – Check the Leak Detection Pump - V144- . Refer to ⇒ “3.6.21 Leak Detection Pump V144 , Checking”, page 191 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0456	Evaporative Emission System Leak Detected Very Small Leak	• Time for pressure drop, < 4.5 – 6.0 s	• Time after engine start 12.0 – 1,000 s • ECT 3.8 – 120° C • ECT at start 3.8 – 50.3° C • Engine off time > 21,600.0 s • Ambient air temp 3.8 – 59.3° C • Ambient air temp drop after start < 4.5 K • Intake manifold vac. > -2,560 hPa • Intake manifold vac. > -2,560 hPa • Altitude < 2,700 m • Veh. speed >= 0 km/h • Veh speed once > 40 km/h • Any drive gear • Restart temp diff. > 0 K • Purge valve closed • LDP active	• 180.0 s • Once per / DCY	• 2 DCY	– Check the EVAP system for leaks. Refer to ⇒ “2.2.4 EVAP System, Checking for Leaks”, page 6 . – Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.11 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 172 . – Check the Leak Detection Pump - V144- . Refer to ⇒ “3.6.21 Leak Detection Pump V144 , Checking”, page 191 .
P0458	Evaporative Emission System Purge Control Valve Circuit Low	• Signal voltage 0 – 3.26 V	• EVAP purge valve, Commanded off • Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.11 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 172 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0459	Evaporative Emission System Purge Control Valve Circuit High	• Signal current > 2.2 A	• EVAP purge valve, Commanded On • Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.11 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 172 .
P0491	Secondary Air System flow check during catalyst heating	• Diff. of measured AIR pressure before AIR injection vs. AIR pressure after AIR injection <= 5.00 kPa • Case 1: blockage: relative AIR pressure measured with AIR pressure sensor vs. modeled >= 0.10 [-] leakage: relative AIR pressure measured with AIR pressure sensor vs. modeled >= 0.10 [-] • Case 2: blockage: relative AIR pressure measured with AIR pressure sensor vs. modeled >= 0.60 [-] leakage: relative AIR pressure measured with AIR pressure sensor vs. modeled >= 0.60 [-] • Case 3: average pressure difference between absolute value and filtered value while AIR valve closed n.a.	• ECT 5 – 115° C • IAT 5.3 – 60° C • Modeled catalyst temp. < 700° C • Mass air flow 7.0 – 140.0 kg/h • Delta engine load -7.0 – 7.0%/rev • Altitude < 2,700 m • AIR System = Commanded On	• 0.0 s • Once / DCY	• 2 DCY	– Check the Secondary Air Injection Solenoid Valve - N112- . Refer to ⇒ “3.6.29 Secondary Air Injection Solenoid Valve N112 , Checking”, page 210 . – Check the Secondary Air Injection Pump Relay - J299- / Secondary Air Injection Pump Motor - V101- . Refer to ⇒ “3.6.27 Secondary Air Injection Pump Relay J299 / Secondary Air Injection Pump Motor V101 , Checking”, page 206 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0501	Vehicle Speed Sensor Range/ Performance	• VSS signal < 6 MPH	• Engine torque > 120 Nm • Engine speed > 2,800 RPM	• 2,000.0 ms	• 2 DCY	– Check vehicle speed signal. Refer to ⇒ “3.6.33 Vehicle Speed Signal, Checking”, page 218 .
P0503	Vehicle Speed Sensor Intermittent/Erratic/ High	• Vehicle speed > 180 MPH		• 0.5 s	• 2 DCY	– Check vehicle speed signal. Refer to ⇒ “3.6.33 Vehicle Speed Signal, Checking”, page 218 .
P0506	Idle Air Control System RPM Lower Than Expected	• Integrated engine speed deviation > 2,000 RPM • Or • Engine speed deviation > 80 RPM	• Engine speed idle • Vehicle speed 0 MPH • Altitude < 2,700 m • IAT > -48° C • ECT > -48° C • Time after engine start > 0.0 s • Lambda control active	• 3.0 – 5.0 s	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 213 .
P0507	Idle Air Control System RPM Higher Than Expected	• Idle speed Deviation < -80 RPM	• Engine speed, idle • Vehicle speed 0 MPH • Altitude < 2700 m • IAT, > -48 °C • ECT, > -48 °C • Time after engine start > 0 s • Lambda control active	• 6.0 s	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 213 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P050A	Cold Start Idle Air Control System Performance	• Out of range low: • Engine speed deviation < -80 RPM • Out of range high: • Engine speed deviation > 80 RPM	• Out of range low: • Time after engine start > 0.0 s • Engine speed, idle • Veh speed 0 km/h • Altitude < 2,700 m • IAT > -48.0° C • Catalyst heating active • ECT < 143° C • Lambda control active • EVAP purge adaptation < 22 • External torque request active	• 3.0 – 5.0 s	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇨ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 213 .
P050B	Cold Start Ignition Timing Performance	• Difference between commanded spark timing vs. actual value > 20%	• Time during catalyst heating > 12.0 s • Commanded spark retard during catalyst heating < 100% • Idle speed not active • Vehicle speed >= 5 km/h • Delta engine load <= 10.01% • Delta engine speed <= 100 RPM	• 10.0 s • Once / DCY	• 2 DCY	– Check for any Engine Speed sensor or Ignition Coil faults and diagnose them first. If NO other codes are set, replace the Engine Control Module - J623- . Refer to appropriate repair manual.

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P052A	Cold Start Camshaft Position Timing Over-Advanced	• Difference between target and actual position > 6° CRK	• Time after engine start >= 15.0 s • Engine speed >= 0 RPM • Modeled oil temperature >= -13° C • Catalyst heating active	• 5.0 s	• 2 DCY	– Check engine oil for incorrect viscosity or in need of servicing (dirty oil). Oil that is not clear in color may be causing the sensor to operate incorrectly. The engine oil must be clean and of the correct viscosity in order for the sensor to operate properly. Check the vehicle paperwork to determine what oil viscosity has been used and when the last oil change was performed. Change the engine oil if necessary. – Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.2 Camshaft Adjustment Valve 1 N205 , Checking”, page 155 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P053F	Cold Start Fuel Pressure Performance	• Difference between target pressure vs actual pressure: > 1.50 MPa • Or • < -1.50 MPa	• Time after engine start 3.0 s • Fuel cutoff not active • Catalyst heating active	• 3.0 s	• 2 DCY	– Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.14 Fuel Pressure Regulator Valve N276 , Checking”, page 178 . – Check the fuel pressure and delivery quantity. Refer to fuel system mechanical testing in ⇒ “3.1 Preliminary Check”, page 13 and/or to appropriate repair manual.
P0606	ECM Processor Fault	• ECM internal check failure • Or • BARO failure (located in the ECM)	• Key on or engine running	• 2.0 s • Continuous	• 2 DCY	– Replace the Engine Control Module - J623- . Refer to appropriate repair manual.
P062B	Internal Control Module Fuel Injector Control Performance	• Internal logic failure	• Engine speed > 80 RPM	• 2.2 s	• 2 DCY	– Replace the Engine Control Module - J623- . Refer to appropriate repair manual.
P0638	Throttle Actuator Control Range/ Performance	• Time to close to reference point > 0.6 s • And • Reference point 2.88% • TPS 1 signal 0.40 – 0.60 V • TPS 2 signal 4.20 – 4.60 V • TPS 1 • And • TPS 2 4.82 – 5.18 V	• Engine speed 0 RPM • Vehicle speed 0 km/h • ECT > 5.3 – 114.8° C • IAT > 5.3 – 143.8° C • Engine shutoff time 5.0 s • Number of checks = 2	• 0.3 – 5.0 s	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 213 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0641	Sensor Reference Voltage A Circuit Open	• Signal voltage deviation > +/- 0.3 V		• 0.5 s	• 2 DCY	– If a related sensor voltage code is also set, refer to that sensor for diagnosis first. If no other related codes set, replace the Engine Control Module - J623- . Refer to appropriate repair manual.
P0651	Sensor Reference Voltage B Circuit Open	• Signal voltage deviation > +/- 0.3 V		• 0.5 s	• 2 DCY	– If a related sensor voltage code is also set, refer to that sensor for diagnosis first. If no other related codes set, replace the Engine Control Module - J623- . Refer to appropriate repair manual.
P0657	Actuator Supply Voltage Circuit Open	• Signal voltage, > 4.4 – 5.6 V	• Relay commanded off • Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Motronic Engine Control Module Power Supply Relay - J271- . Refer to ⇒ “3.6.23 Motronic Engine Control Module Power Supply Relay J271 , Checking”, page 195 .
P0658	Actuator Supply Voltage Circuit Low	• Signal voltage, < 2.15 – 3.25 V	• Relay commanded off • Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Motronic Engine Control Module Power Supply Relay - J271- . Refer to ⇒ “3.6.23 Motronic Engine Control Module Power Supply Relay J271 , Checking”, page 195 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P0659	Actuator Supply Voltage Circuit High	• Signal current > 1.1 A	• Relay commanded on • Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Motronic Engine Control Module Power Supply Relay - J271- . Refer to ⇒ “3.6.23 Motronic Engine Control Module Power Supply Relay J271 , Checking”, page 195 .
P0697	Sensor Reference Voltage Circuit Open	• Signal voltage deviation > +/- 0.3 V		• 0.5 s	• 2 DCY	– If a related sensor voltage code is also set, refer to that sensor for diagnosis first. If no other related codes set, replace the Engine Control Module - J623- . Refer to appropriate repair manual.
P117A	Bank 1 Sensor 2 Control Limit Reached	• I portion of 3rd lambda control loop > 0.030 [-]	• Engine speed 1,200 – 4,000 RPM • Modeled exhaust gas temp 350 – 1,000° C • Engine load 21.8 – 99.8% • 1st, 2nd, 3rd lambda control in closed loop • O2S rear and heater ready no faults	• 800.0 s	• 2 DCY	– Check the Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P12A1	Fuel Rail Pressure Sensor Inappropriately Low	• Pressure control activity > 0.20 MPa • Fuel trim activity < 0.80 • Difference between actual pressure vs target pressure 16.38 – 16.38 MPa	• Engine speed > 600 RPM • EVAP purge adaption < 22.0 • ECT >= 63° C • IAT < 90° C • Lambda control closed loop • Fuel cutoff not active	• 5.0 s	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.15 Fuel Pressure Sensor G247 , Checking”, page 180 . – Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.14 Fuel Pressure Regulator Valve N276 , Checking”, page 178 .
P12A2	Fuel Rail Pressure Sensor Inappropriately High	• Pressure control activity < -0.05 MPa • Fuel trim activity > 1.65 • Difference between target pressure and actual pressure -16.38 – 16.38 MPa	• Engine speed > 600 RPM • EVAP purge adaption < 22.0 • ECT >= 63° C • IAT < 90° C • Lambda control closed loop • Fuel cutoff not active	• 5.0 s	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.15 Fuel Pressure Sensor G247 , Checking”, page 180 . – Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.14 Fuel Pressure Regulator Valve N276 , Checking”, page 178 .
P12A4	Fuel Rail Pump Control Valve Stuck Closed	• Fuel trim activity .90 to 1.15 • Pressure control activity < -6 MPa • System Deviation < 16.38 MPa	• Engine speed > 600 RPM • EVAP purge adaption < 22.0 • ECT >= 63° C • IAT < 90° C • Lambda control closed loop • Fuel cutoff not active	• 5.0 s	• 2 DCY	– Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.14 Fuel Pressure Regulator Valve N276 , Checking”, page 178 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P13EA	Cold Start Ignition Timing Performance Off Idle	• Difference between commanded spark timing vs. actual value > 40%	• Time during catalyst heating > 12.0 s • Commanded spark retard during catalyst heating < 100% • Idle speed not active • Vehicle speed >= 5 km/h • Delta engine load <= 10.01% • Delta engine speed <= 100 RPM	• 10.0 s • Once / DCY	• 2 DCY	– Check for any Engine Speed sensor or Ignition Coil faults and diagnose them first. If NO other codes are set, replace the Engine Control Module - J623- . Refer to appropriate repair manual.
P150A	Engine Off Timer Performance	• Difference between engine off time and ECM after run time < -12.0 s or > 12.0 s	• Key on after ECM after run time active • Key on during ECM after run time active • CAN active	• 6.0 s	• 2 DCY	– If ignition off B+ is lost to ECM, this code will set. Check power and ground inputs to ECM first. Refer to Wiring Diagrams for pin locations. If all power/ grounds to ECM are present, replace the Engine Control Module - J623- . Refer to appropriate repair manual.
P2008	Intake Manifold Runner Control Circuit Open	• Signal voltage 4.70 – 5.40 V	• Tumble flap commanded off • Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Intake Manifold Runner Control Valve - N316- . Refer to ⇒ “3.6.18 Intake Manifold Runner Control Valve N316 , Checking”, page 186 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2009	Intake Manifold Runner Control Circuit Low	• Signal voltage 0 – 3.26 V	• Tumble flap commanded off • Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Intake Manifold Runner Control Valve - N316- . Refer to ⇒ “3.6.18 Intake Manifold Runner Control Valve N316 , Checking”, page 186 .
P2010	Intake Manifold Runner Control Circuit High	• Signal current > 2.20 A	• Tumble flap commanded on • Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Intake Manifold Runner Control Valve - N316- . Refer to ⇒ “3.6.18 Intake Manifold Runner Control Valve N316 , Checking”, page 186 .
P2014	Intake Manifold Runner Position Sensor Circuit	• Signal voltage > 4.75 V		• 0.3 s	• 2 DCY	– Check the Intake Manifold Runner Position Sensor - G336- . Refer to ⇒ “3.6.19 Intake Manifold Runner Position Sensor G336 , Checking”, page 187 .
P2015	Intake Manifold Runner Position Sensor Circuit Range/Performance	• Deviation runner flap target position vs actual position > 25% • Actual position 0 – 100%	• Flap commanded on or off • Adaptation ready	• 1.5 s	• 2 DCY	– Check the Intake Manifold Runner Position Sensor - G336- . Refer to ⇒ “3.6.19 Intake Manifold Runner Position Sensor G336 , Checking”, page 187 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2016	Intake Manifold Runner Position Sensor Circuit Low	• Signal voltage < 0.25 V		• 0.3 s	• 2 DCY	– Check the Intake Manifold Runner Position Sensor - G336- . Refer to ⇒ “3.6.19 Intake Manifold Runner Position Sensor G336 , Checking”, page 187 .
P2088	A Camshaft Position Actuator Control Circuit Low	• Signal voltage 0 – 3.25 V	• Camshaft valve off • Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.2 Camshaft Adjustment Valve 1 N205 , Checking”, page 155 .
P2089	A Camshaft Position Actuator Control Circuit High	• Signal current > 2.2 A	• Camshaft valve on • Engine speed > 80 RPM	• 0.5 s	• 2 DCY	– Check the Camshaft Adjustment Valve 1 - N205- . Refer to ⇒ “3.6.2 Camshaft Adjustment Valve 1 N205 , Checking”, page 155 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2096	Post Catalyst Fuel Trim System Too Lean	• I-portion of 2nd lambda control < -0.040 [-]	• Modeled exhaust gas temp 450 – 850° C • For time > 20.0 s • Lambda control closed loop • Lambda control not at min or max limit • 2nd lambda control closed loop • O2S front ready no DTC • O2S rear ready no DTC • HO2S heaters active • Integrated exhaust gas mass > 120.0 g • After the following mixture disturbances: • Time fuel cut-off > 0.5 s • Deviation engine load > 35.0% • ECT < 50° C • Catalyst heating active • AIR, active • Lambda set point <1; > 1 • Catalyst purge active • Engine speed < 1,000 RPM • For time > 2.0 s • Disabling the offset adaptation after repeat transients within a short time: • Acceleration enrichment, active • Deceleration enleanment, active • Then	• 60.0 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 . – Check the Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 . – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.24 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 197 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
			• Exhaust gas mass flow 14.0 – 300.0 kg/h • Exhaust gas mass flow 14.0 kg/h • Within time 2.0 s			

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2097	Post Catalyst Fuel Trim System Too Rich	• I-portion of 2nd lambda control > 0.040 [-]	• Modeled exhaust gas temp 450 – 850° C • For time > 20.0 s • Lambda control closed loop • Lambda control not at min or max limit • 2nd lambda control closed loop • O2S front ready no DTC • O2S rear ready no DTC • HO2S heaters active • Integrated exhaust gas mass > 120.0 g • After the following mixture disturbances: • Time fuel cut-off > 0.5 s • Deviation engine load > 35.0% • ECT < 50° C • Catalyst heating, active • AIR active • Lambda set point <1; > 1 • Catalyst purge, active • Engine Speed < 1,000 RPM • For time > 2.0 s • Disabling the offset adaptation after repeat transients within a short time: • Acceleration enrichment, active • Deceleration enleanment, active • Then	• 60.0 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 . – Check the Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 . – Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.24 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 197 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
			• Exhaust gas mass flow 14.0 – 300.0 kg/h • Exhaust gas mass flow 14.0 kg/h • Within time 2.0 s			
P2101	Throttle Actuator Control Motor Circuit Range/Performance	• Duty cycle > 80% • Deviation throttle value angles vs. calculated value 4 - 50% • ECM power stage no failure		• 0.5 – 5.0 s	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 213 .
P2106	Throttle Actuator Control System - Forced Limited Power	• Internal check failed	• Duty cycle > 80% or deviation throttle value angles vs. calculated value > 4 – 50%	• 0.5 – 5.0 s	• 2 DCY	– Check the Throttle Valve Control Module - GX3- . Refer to ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 213 .
P2122	APP Sensor 1/APP Sensor 2 Circuit D Low Input	• Signal voltage < 0.61 V		• 0.5 s	• 2 DCY	– Check the Accelerator Pedal Module - GX2- . Refer to ⇒ “3.6.1 Accelerator Pedal Module GX2 , Checking”, page 153 .
P2123	APP Sensor 1/APP Sensor 2 Circuit D High Input	• Signal voltage > 4.79 V		• 0.5 s	• 2 DCY	– Check the Accelerator Pedal Module - GX2- . Refer to ⇒ “3.6.1 Accelerator Pedal Module GX2 , Checking”, page 153 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2127	APP Sensor 1/APP Sensor 2 Circuit E Low Input	• Signal voltage < 0.27 V		• 0.5 s	• 2 DCY	– Check the Accelerator Pedal Module - GX2- . Refer to ⇒ “3.6.1 Accelerator Pedal Module GX2 , Checking”, page 153 .
P2128	APP Sensor 1/APP Sensor 2 Circuit E High Input	• Signal voltage > 2.43 V		• 0.5 s	• 2 DCY	– Check the Accelerator Pedal Module - GX2- . Refer to ⇒ “3.6.1 Accelerator Pedal Module GX2 , Checking”, page 153 .
P2138	APP Sensor 1/APP Sensor 2 Circuit D/E Voltage Correlation	• Signal voltage: Difference between signal APP1 and APP2 > 0.17 – 0.70 V	• Signal voltage sensor 1 > 445.0 mv • Signal voltage sensor 2 > 445.0 mv	• 0.24 s	• 2 DCY	– Check the Accelerator Pedal Module - GX2- . Refer to ⇒ “3.6.1 Accelerator Pedal Module GX2 , Checking”, page 153 .
P2146	Fuel Injector Group A Supply Voltage Circuit Open	• Signal current < 2.6 A • Or • Signal current > 14.90 A	• Engine speed > 80 RPM • Or • Low side signal current > 2.70 A	• 0.5 s	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.13 Fuel Injectors, Checking”, page 176 .
P2149	Fuel Injector Group B Supply Voltage Circuit Open	• Signal current < 2.6 A • Or • Signal current > 14.90 A	• Engine speed > 80 RPM • Or • Low side signal current > 2.70 A	• 0.5 s	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.13 Fuel Injectors, Checking”, page 176 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2177	System too lean @ part load	• Adaptive value > 28%	• Engine speed 1,280 – 6,000 RPM • Engine load 20 – 100% • Mass air flow 30 – 300 kg/h • ECT > 63° C • IAT < 90° C • Lambda control closed loop • Evap purge valve closed	• 10.0 s	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.13 Fuel Injectors, Checking”, page 176 . – Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 . – Check the fuel pressure and delivery quantity. Refer to fuel system mechanical testing in ⇒ “3.1 Preliminary Check”, page 13 and/or to appropriate repair manual. – Check the intake system visually for leaks (false air). – Check the vacuum lines visually for leaks.

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2178	System Too Rich Off Idle	• Adaptive value < -21%	• Engine speed 1,280 – 6,000 RPM • Engine load 20 – 100% • Mass air flow 30 – 300 kg/h • ECT > 63° C • IAT < 90° C • Lambda control closed loop • Evap purge valve closed	• 10.0 s	• 2 DCY	– Check the Fuel Injectors . Refer to ⇒ “3.6.13 Fuel Injectors, Checking”, page 176 . – Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 . – Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.11 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 172 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2181	Cooling System Performance	• Cooling system temperature too low after a sufficient mass air flow integral 74 – 84° C	• Begin of air mass integration when engine temp > 30° C • ECT at start -7 – 64° C • Ambient air temp -7° C • Fuel cutoff not active and engine load 0 – 400% • Delta ambient pressure < 1.5 kPa • Integrated air mass depending on engine temp at start and ambient air temperature 4 – 23 kg/h • Accumulated fuel cutoff < 40.0 – 250.0 s • At time of fault decision • Average mass air flow 20 – 154 kg/h • Average veh. speed 33.4 – 120 km/h	• 2.0 s	• 2 DCY	– Check Engine Coolant Temperature Sensor - G62- . Refer to ⇒ “3.6.8 Engine Coolant Temperature Sensor G62 , Checking”, page 167 . – Check Engine Coolant Temperature Sensor On Radiator Outlet - G83- . Refer to ⇒ “3.6.9 Engine Coolant Temperature Sensor On Radiator Outlet G83 ”, page 169 . – Check the Coolant Circulation Pump Relay - J151- / After-Run Coolant Pump - V51- . Refer to ⇒ “3.6.7 Coolant Circulation Pump Relay J151 / After-Run Coolant Pump V51 , Checking”, page 165 . – Check the Coolant Thermostat. Refer to appropriate repair manual.

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2184	Engine Coolant Temperature Sensor 2 Circuit Low	• ECT outlet > 141° C		• 2.0 s	• 2 DCY	– Check Engine Coolant Temperature Sensor On Radiator Outlet - G83- . Refer to ⇒ “3.6.9 Engine Coolant Temperature Sensor On Radiator Outlet G83 ”, page 169 .
P2185	Engine Coolant Temperature Sensor 2 Circuit High	• ECT outlet < -43° C		• 2.0 s	• 2 DCY	– Check Engine Coolant Temperature Sensor On Radiator Outlet - G83- . Refer to ⇒ “3.6.9 Engine Coolant Temperature Sensor On Radiator Outlet G83 ”, page 169 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2187	System Too Lean At Idle	• Adaptive value > 5.02%	• Engine speed 520 – 1,200 RPM • Engine load < 17 – 45% • Mass air flow 5 – 26 kg/h • ECT > 63° C • IAT < 90° C • Delta part load adaptation ready • Lambda closed loop • EVAP purge valve closed	• 10.0 s	• 2 DCY	– Check the intake system visually for leaks (air not metered through the MAF). – Check the vacuum lines visually for leaks. – Check the fuel pressure and delivery quantity. Refer to fuel system mechanical testing in ⇒ “3.1 Preliminary Check”, page 13 and/or to appropriate repair manual. – Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.15 Fuel Pressure Sensor G247 , Checking”, page 180 . – Check the Fuel Injectors . Refer to ⇒ “3.6.13 Fuel Injectors, Checking”, page 176 . – Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2188	System Too Rich At Idle	• Adaptive value < -5.02%	• Engine speed 520 – 1,200 RPM • Engine load < 17 – 45% • Mass air flow 5 – 26 kg/h • ECT > 63° C • IAT < 90° C • Delta part load adaptation ready • Lambda closed loop • EVAP purge valve closed	• 10.0 s	• 2 DCY	– Check the Fuel Pressure Sensor - G247- . Refer to ⇒ “3.6.15 Fuel Pressure Sensor G247 , Checking”, page 180 . – Check the Fuel Injectors . Refer to ⇒ “3.6.13 Fuel Injectors, Checking”, page 176 . – Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 . – Check the EVAP Canister Purge Regulator Valve 1 - N80- . Refer to ⇒ “3.6.11 EVAP Canister Purge Regulator Valve 1 N80 , Checking”, page 172 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2195	HO2S Sensor Signal Out of Range Lean Bank 1 Sensor 1	• Delta lambda of 2nd lambda control loop > 0.080 [-]	• Modeled exhaust gas temp 450 – 850° C • Delta engine load < 20% • Exh. gas mass flow 14 – 300 kg/h • Lambda control, 2nd lambda control, closed loop • O2S front, rear and heaters ready – no fault • Fuel cutoff, catalyst heating, SAI - not active • 1st lambda control loop not at min or max • 2nd lambda control loop active	• 95.0 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .
P2196	HO2S Sensor Signal Out of Range Rich Bank 1 Sensor 1	• Delta lambda of 2nd lambda control loop < -0.080 [-]	• Modeled exhaust gas temp 450 – 850° C • Delta engine load < 20% • Exh. gas mass flow 14 – 300 kg/h • Lambda control 2nd lambda control, closed loop • O2S front, rear and heaters ready – no fault • Fuel cutoff, catalyst heating, SAI – not active • 1st lambda control loop not at min or max • 2nd lambda control loop active	• 95.0 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2231	HO2S Sensor Bank 1 Sensor 1 Signal Circuit Shorted to Heater Circuit	• Delta O2S signal front > 190 uA	• Engine speed < 2,700 RPM • Engine load < 60% • Heater duty cycle 20 – 80% • Modeled exhaust gas temp < 800.1° C • Lambda 0.95 – 1.05 [-] • Heater control closed loop no fault	• 15.0 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .
P2237	HO2S Sensor Positive Current Control Circuit Open Bank 1 Sensor 1	• O2S signal front 1.49 – 1.51 V • Delta lambda controller > 0.10	• O2S ceramic temp 715° C • Lambda control closed loop • Modeled exhaust gas temp > 700° C • Lambda modulation > 0.02 • Heater control closed loop	• 5.0 – 8.0 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .
P2243	HO2S Sensor Reference Voltage Circuit Open Bank 1 Sensor 1	• O2S signal front > 3.25 V • And • Internal resistance > 1,000 Ω • O2S signal front < 0.30 V • And • Internal resistance > 1,000 Ω	• Heater control active	• 20.0 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .
P2251	HO2S Sensor Negative Current Control Circuit Open Bank 1 Sensor 1	• O2S signal front 1.47 – 1.53 V • And • Internal resistance > 1,000 Ω	• Modeled exhaust gas temp < 700° C • No fuel cutoff > 2.0 s • Heater control active	• 25.0 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2257	Secondary Air Injection Relay Control Circuit Short to Ground	• Signal voltage 0 – 3.26 V	• Pump relay commanded off • Engine speed > 80 mph	• 0.5 s	• 2 DCY	– Check the Secondary Air Injection Pump Relay - J299- / Secondary Air Injection Pump Motor - V101- . Refer to ⇒ “3.6.27 Secondary Air Injection Pump Relay J299 / Secondary Air Injection Pump Motor V101 , Checking”, page 206 .
P2258	Secondary Air Injection Relay Control Circuit Short to Battery Voltage	• Signal current 0.60 – 2.40 A	• Pump relay commanded on • Engine speed > 80 mph	• 0.5 s	• 2 DCY	– Check the Secondary Air Injection Pump Relay - J299- / Secondary Air Injection Pump Motor - V101- . Refer to ⇒ “3.6.27 Secondary Air Injection Pump Relay J299 / Secondary Air Injection Pump Motor V101 , Checking”, page 206 .
P2270	HO2S Sensor Signal Stuck Lean Bank 1 Sensor 2	• O2S signal rear < -2.0 mV • Enrichment after stuck lean 27.9%	• Mass air flow 25 – 150 kg/h • Modeled exhaust gas temp > 350° C • HO2S readiness > 30.0 s • 2nd lambda control closed loop	• 95.0 s	• 2 DCY	– Check the Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2271	HO2S Sensor Signal Stuck Rich Bank 1 Sensor 2	• Sensor voltage of >= 0.15 V • After oxygen mass flow > 3,000.0 mg • Number of checks >= 1	• Time of fuel cutoff <= 90.0 s • Time after last fuel cutoff >= 20.0 s • HO2S rear ready • Exhaust temp at sensor >= 385° C • Exhaust mass flow > 12 kg/h • Exhaust mass flow dynamic within range -80 – 80 kg/h	• 10.0 s	• 2 DCY	– Check the Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to ⇒ “3.6.26 Oxygen Sensor 2 Before Catalytic Converter GX11 , Checking”, page 203 .
P2274	HO2S Sensor Signal Stuck Lean Bank 1 Sensor 3	• O2S rear signal not oscillating at reference < 0.62 – 0.65 V • Enrichment after stuck lean 27.9%	• Mass air flow 25 – 150 kg/h • O2S rear readiness > 30.0 s • Modeled exhaust gas temp > 350° C • 2nd lambda control closed loop	• 215.0 s	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.24 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 197 .
P2275	HO2S Sensor Signal Stuck Rich Bank 1 Sensor 3	• O2S sensor voltage >= 0.15 V • After oxygen mass flow (fuel cutoff) > 4,500.0 mg • Number of checks >= 1	• Time of fuel cutoff <= 90.0 s • Time after last fuel cutoff >= 20.0 s • O2S rear ready • Exhaust temp at sensor >= 385° C • Exhaust mass flow > 12 kg/h • Exhaust mass flow dynamic within range -80 – 80 kg/h • Sensor voltage at start of measurement > 0.45 V	• 10.0 s	• 2 DCY	– Check the Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to ⇒ “3.6.24 Oxygen Sensor 1 After Catalytic Converter GX7 , Checking”, page 197 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2279	Intake Air System Leak	• Threshold to detect a defective system > 1.33 – 1.60	• Time after engine start > 60.0 s • Engine load < 40% • Mass air flow < 6,553.50 kg/h • ECT > 49.50° C • IAT < 99.80° C • Lambda control value > 0.95 • Lambda set value 0.95 – 1.05 • Veh speed < 1 km/h • Lambda control active • Engine speed – idle • Altitude < 2,700 m • O2S front – no fault	• 23.0 s	• 2 DCY	– Check for air leaks between MAF and throttle body, oil fill cap not tight or oil dipstick not seated in tube. Also any engine gaskets that can cause additional air to enter the crankcase can set this fault as the PCV system is not metered. If a vacuum leak or crankcase gasket sealing is at cause, the idle may be rough or unstable.
P2293	Fuel Pressure Regulator 2 Performance	• Difference between target pressure vs actual pressure: > 1.50 MPa • Or • < -1.50 MPa	• Time after engine start 3.0 s • Fuel cutoff not active	• 3.5 s	• 2 DCY	– Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.14 Fuel Pressure Regulator Valve N276 , Checking”, page 178 .
P2294	Fuel Pressure Regulator 2 Control Circuit	• Signal voltage 1.40 – 3.20 V • Or • Signal pattern incorrect	• Fuel control valve commanded Off • Fuel pump commanded On	• 0.5 s	• 2 DCY	– Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.14 Fuel Pressure Regulator Valve N276 , Checking”, page 178 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2295	Fuel Pressure Regulator 2 Control Circuit Low	• Signal voltage 1.40 – 3.20 V	• Fuel control valve commanded Off	• 0.5 s	• 2 DCY	– Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.14 Fuel Pressure Regulator Valve N276 , Checking”, page 178 .
P2296	Fuel Pressure Regulator 2 Control Circuit High	• Signal voltage > 3.20 V	• Fuel control valve commanded On	• 0.5 s	• 2 DCY	– Check the Fuel Pressure Regulator Valve - N276- . Refer to ⇒ “3.6.14 Fuel Pressure Regulator Valve N276 , Checking”, page 178 .
P2300	Ignition Coil A Primary Control Circuit Low	• Signal current > 24.0 mA	• Engine speed > 680 RPM	• 2.0 s • Continuous	• 2 DCY	– Check the Ignition Coils with Power Output Stage - N70- . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 .
P2301	Ignition Coil A Primary Control Circuit High	• Signal voltage > 5.1 – 7.0 V	• Engine speed > 680 RPM	• 2.0 s • Continuous	• 2 DCY	– Check the Ignition Coil with Power Output Stage - N70- . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2303	Ignition Coil B Primary Control Circuit Low	• Signal current > 24.0 mA	• Engine speed > 680 RPM	• 2.0 s • Continuous	• 2 DCY	– Check the Ignition Coil with Power Output Stage - N127- . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 .
P2304	Ignition Coil B Primary Control Circuit High	• Signal voltage > 5.1 – 7.0 V	• Engine speed > 680 RPM	• 2.0 s • Continuous	• 2 DCY	– Check the Ignition Coil with Power Output Stage - N127- . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 .
P2306	Ignition Coil C Primary Control Circuit Low	• Signal current > 24.0 mA	• Engine speed > 680 RPM	• 2.0 s • Continuous	• 2 DCY	– Check the Ignition Coil with Power Output Stage - N291- . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 .
P2307	Ignition Coil C Primary Control Circuit High	• Signal voltage > 5.1 – 7.0 V	• Engine speed > 680 RPM	• 2.0 s • Continuous	• 2 DCY	– Check the Ignition Coil with Power Output Stage - N291- . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2309	Ignition Coil D Primary Control Circuit Low	• Signal current > 24.0 mA	• Engine speed > 680 RPM	• 2.0 s • Continuous	• 2 DCY	– Check the Ignition Coil with Power Output Stage - N292- . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 .
P2310	Ignition Coil D Primary Control Circuit High	• Signal voltage > 5.1 – 7.0 V	• Engine speed > 680 RPM	• 2.0 s • Continuous	• 2 DCY	– Check the Ignition Coil with Power Output Stage - N292- . Refer to ⇒ “3.6.16 Ignition Coils With Power Output Stage , Checking”, page 182 .
P240 A	EVAP System Leak Detection Pump Heater Control Circuit/ Open	• Signal voltage > 4.70 – 5.40 V	• EVAP pump heater commanded Off	• 0.5 s	• 2 DCY	– Check the Leak Detection Pump - V144- . Refer to ⇒ “3.6.21 Leak Detection Pump V144 , Checking”, page 191
P240 B	EVAP System Leak Detection Pump Heater Control Circuit Low	• Signal voltage < 2.74 – 3.26 V	• EVAP pump heater commanded Off	• 0.5 s	• 2 DCY	– Check the Leak Detection Pump - V144- . Refer to ⇒ “3.6.21 Leak Detection Pump V144 , Checking”, page 191 .
P240 C	EVAP System Leak Detection Pump Heater Control Circuit High	• Signal current > 2.2 – 4.0 A	• EVAP pump heater commanded ON	• 0.5 s	• 2 DCY	– Check the Leak Detection Pump - V144- . Refer to ⇒ “3.6.21 Leak Detection Pump V144 , Checking”, page 191 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2400	Evaporative Emission System Leak Detection Pump Control Circuit Open	• Signal voltage > 4.4 – 5.6 V	• LDP commanded off • Engine speed 80 RPM	• 0.5 s	• 2 DCY	– Check the Leak Detection Pump - V144- . Refer to ⇒ “3.6.21 Leak Detection Pump V144 , Checking”, page 191 .
P2401	Evaporative Emission System Leak Detection Pump Control Circuit Short to Ground	• Signal voltage > 2.15 – 3.25 V	• LDP commanded Off • Engine speed 80 RPM	• 0.5 s	• 2 DCY	– Check the Leak Detection Pump - V144- . Refer to ⇒ “3.6.21 Leak Detection Pump V144 , Checking”, page 191 .
P2402	Evaporative Emission System Leak Detection Pump Control Circuit Short to Battery Voltage	• Signal current > 3 A	• LDP commanded On • Engine speed 80 RPM	• 0.5 s	• 2 DCY	– Check the Leak Detection Pump - V144- . Refer to ⇒ “3.6.21 Leak Detection Pump V144 , Checking”, page 191 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2403	Evaporative Emission System Leak Detection Pump Sense Circuit Open	• Low signal voltage > 0.5 s	• Time after engine start 5.0 – 65,530.0 s • ECT 5 – 120° C • ECT at start 5 – 50° C • Engine off time > 21,600.0 s • Altitude < 2,700 m • Integrated purge flow > 12 g • Restart temp diff > 0 K • Veh speed >= 0 km/h • Veh speed ones > 30 km/h • Any drive gear • EVAP purge valve ready, no faults • LDP commanded off	• 0.5 s • Once / DCY	• 2 DCY	– Check the Leak Detection Pump - V144- . Refer to ⇒ “3.6.21 Leak Detection Pump V144 , Checking”, page 191 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2404	Evaporative Emission System Leak Detection Pump Sense Range/Performance	• High signal voltage > 12.0 s • Number of checks = 30 • Cumulative time of high signal voltage during pumping > 10.0 s	• Time after engine start 12.0 – 65,530.0 s • Engine off time > 21,600.0 s • ECT 5 – 120° C • ECT at start 5 – 50° C • Ambient air temp 5 – 59° C • Altitude < 2,700 m • Intake manifold vacuum > -2,560 hPa • Restart temp diff > 0 K • Veh speed >= 0 km/h • Veh speed ones > 30 km/h • Any drive gear • EVAP purge valve ready, no faults • LDP commanded off	• 12.0 – 151.0 s • Once / DCY	• 2 DCY	– Check the Leak Detection Pump - V144- . Refer to ⇒ “3.6.21 Leak Detection Pump V144 , Checking”, page 191 .
P2407	Evaporative Emission System Leak Detection Pump Sense Circuit Intermittent/Erratic	• Fluctuation of EVAP pump current during reference measurement engine off > 2.0 mA • Or • Drop of EVAP pump current during pump phase of 3.0 s > 6.0 mA	• ECT @ start >= 4° C • Difference between ECT and IAT @ start <= 15K • Engine off time >= 5.0 s • Airbag not activated	• 800.0 s	• 2 DCY	– Check the Leak Detection Pump - V144- . Refer to ⇒ “3.6.21 Leak Detection Pump V144 , Checking”, page 191 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
		• Fluctuation of EVAP pump current during reference measurement engine on > 2.0 mA • Or • Drop of EVAP pump current during pump phase of 3.0 s > 6.0 mA	• ECT @ start < 60° C • AAT < 35° C • Time since last engine start>= 600.0 s • Intake manifold vacuum > 30 kPa • Delta vehicle speed < 16 mph • RPM > 20 RPM • Front OS2 ready	• 19.0 s		
P2414	HO2S Sensor Exhaust Sample Error Bank 1, Sensor 1	• Threshold 1 • Signal voltage 3.1 – 4.81 V • Threshold 2 • O2S signal 2.5 – 3.2 V	• Lambda set value < 1.6 • Fuel cut off not active • Heater control, closed loop • SAI not active • O2S ceramic temp > 720° C • If low fuel signal then wait > 0.0 s	• 15.0 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .
P2431	Secondary Air Injection Sensor Performance	• Difference between SAI pressure sensor and ambient pressure NOT -60.0 to 60.0 hPa	• SAI completed	• 0.5 s	• 2 DCY	– Check the Secondary Air Injection Sensor 1 - G609- . Refer to ⇒ “3.6.28 Secondary Air Injection Sensor 1 G609 , Checking”, page 208 .
P2432	Secondary Air Injection Sensor Circuit Low	• Signal voltage < 0.40 V		• 0.5 s • Continuous	• 2 DCY	– Check the Secondary Air Injection Sensor 1 - G609- . Refer to ⇒ “3.6.28 Secondary Air Injection Sensor 1 G609 , Checking”, page 208 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2433	Secondary Air Injection Sensor Circuit High	• Signal voltage > 4.65 V		• 0.5 s • Continuous	• 2 DCY	– Check the Secondary Air Injection Sensor 1 - G609- . Refer to ⇒ “3.6.28 Secondary Air Injection Sensor 1 G609 , Checking”, page 208 .
P2440	Secondary Air Injection System Switching Valve Stuck Open	• Diff. of measured AIR pressure before AIR injection vs. AIR pressure after AIR injection <= 5.00 kPa • Blockage: relative AIR pressure measured with AIR pressure sensor vs. modeled >= 0.60 [-] • Leakage: relative AIR pressure measured with AIR pressure sensor vs. modeled >= 0.60 [-] • Case 1: relative AIR pressure (measured with AIR pressure sensor vs. modeled) vs. relative AIR pressure (measured with AIR pressure sensor vs. modeled while AIR valve closed) > 1.20 [-] • Case 2: average pressure difference between absolute value and filtered value while AIR valve closed n.a.	• ECT 5 – 115° C • IAT 5.3 – 60 °C • Modeled catalyst temp. < 700° C • Mass air flow 7.0 – 140.0 kg/h • Delta engine load -7.0 – 7.0 %/rev • Altitude < 2,700 m • AIR System commanded On	• 0.0 s • Once / DCY	• 2 DCY	– Check the Secondary Air Injection Solenoid Valve - N112- . Refer to ⇒ “3.6.29 Secondary Air Injection Solenoid Valve N112 , Checking”, page 210 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2450	Evaporative Emission System Switching Valve Performance/ Stuck Open	• Engine off EVAP pump current difference between reference measurement to idle < 3mA	• ECT @ start >= 4° C • difference between ECT and IAT @ start <= 15K • engine off time >= 5 sec • airbag not activated	• 13.5 s	• 2 DCY	– Check the Leak Detection Pump - V144- . Refer to ⇒ “3.6.21 Leak Detection Pump V144 , Checking”, page 191 .
		• Engine on EVAP pump current difference between reference measurement to idle >3mA	• ECT @ start < 60° C • AAT < 35° C • Time since last engine start>= 600.0 s • Intake manifold vacuum > 30 kPa • Delta vehicle speed < 16 mph • RPM > 20 RPM • Front OS2 ready	• 4.0 s		
P2568	Direct Ozone Reduction Catalyst Temperature Sensor Circuit Range/ Performance	• ID check failure • Temperature sensor functional check failure	• Engine speed > 400 RPM • ECT at engine start < 35.3° C	• 250.0 s	• 2 DCY	– Check the CAN-Bus terminal resistance. Refer to ⇒ “3.6.4 CAN-Bus Terminal Resistance, Checking”, page 159 .
P2569	Direct Ozone Reduction Catalyst Temperature Sensor Circuit Low	• Electrical error via LIN failure (grounded)		• 2.0 s	• 2 DCY	– Check the CAN-Bus terminal resistance. Refer to ⇒ “3.6.4 CAN-Bus Terminal Resistance, Checking”, page 159 .
P2570	Direct Ozone Reduction Catalyst Temperature Sensor Circuit High	• Electrical error via LIN failure (short to battery, open circuit)		• 2.0 s	• 2 DCY	– Check the CAN-Bus terminal resistance. Refer to ⇒ “3.6.4 CAN-Bus Terminal Resistance, Checking”, page 159 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
P2626	HO2S Sensor Pumping Current Trim Circuit/ Open Bank 1 Sensor 1	• O2S signal front > 4.81 V	• Modeled exhaust temp < 700° C • O2S ceramic temp > 715° C • Fuel cut off, Active • Heater control closed loop • No low fuel signal	• 1.5 s	• 2 DCY	– Check the Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to ⇒ “3.6.25 Oxygen Sensor 1 Before Catalytic Converter GX10 , Checking”, page 200 .
P3081	Engine Temperature Too Low	• Difference between ECT and modeled ECT > 10 K		• 4.0 s	• 2 DCY	– Check the Engine Coolant Temperature Sensor - G62- . Refer to ⇒ “3.6.8 Engine Coolant Temperature Sensor G62 , Checking”, page 167 . – Check Engine Coolant Temperature Sensor On Radiator Outlet - G83- . Refer to ⇒ “3.6.9 Engine Coolant Temperature Sensor On Radiator Outlet G83 ”, page 169 . – Check the engine coolant thermostat. Refer to appropriate repair manual.
U0001	High Speed CAN Communication Bus	• CAN message, no feedback	• Time after ignition on 500.0 ms	• 250.0 ms	• 2 DCY	– Check the CAN-Bus terminal resistance. Refer to ⇒ “3.6.4 CAN-Bus Terminal Resistance, Checking”, page 159 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
U0002	High Speed CAN Communication Bus Performance	• Global Time Out failure	• Time after ignition on 500.0 ms	• 450.0 ms	• 2 DCY	– Check the CAN-Bus terminal resistance. Refer to ⇒ "3.6.4 CAN-Bus Terminal Resistance, Checking", page 159 .
U0101	Lost Communication with TCM	• Time Out failure • No message received by ECM	• Time after ignition on 500.0 ms	• 500.0 ms	• 2 DCY	– Check the CAN-Bus terminal resistance. Refer to ⇒ "3.6.4 CAN-Bus Terminal Resistance, Checking", page 159 .
U0121	Lost Communication With Anti-Lock Brake System (ABS) Control Module	• CAN communication with ABS Time Out - no message	• Time after ignition on 500.0 ms	• 500.0 ms	• 2 DCY	– Check the CAN-Bus terminal resistance. Refer to ⇒ "3.6.4 CAN-Bus Terminal Resistance, Checking", page 159 .
U0146	Lost Communication With Gateway A	• CAN communication with gateway Time Out - no message	• Time after ignition on 500.0 ms	• 500.0 ms	• 2 DCY	– Check the CAN-Bus terminal resistance. Refer to ⇒ "3.6.4 CAN-Bus Terminal Resistance, Checking", page 159 .
U0155	Lost Communication With Instrument Panel Cluster (IPC) Control Module	• No CAN messages received	• Time after ignition on 500.0 ms	• 2,000.0 ms	• 2 DCY	– Check the CAN-Bus terminal resistance. Refer to ⇒ "3.6.4 CAN-Bus Terminal Resistance, Checking", page 159 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
U0302	Software Incompatibility with Transmission Control Module	• AT vehicle ECM coded as MT vehicle	• Time after ignition on 500.0 ms	• 5,000.0 ms	• 2 DCY	– Check for software updates and TSB's. Reprogram as necessary. If none are found, replace the Direct Shift Gearbox (DSG) Mechatronic - J743- . Refer to appropriate repair manual.
U0402	Invalid Data Received From Gear Shift Control Module A	• Transmission Data implausible message	• Time after ignition on 500.0 ms	• 60.0 ms	• 2 DCY	– Check for software updates and TSB's. Reprogram as necessary. If none are found, replace the Direct Shift Gearbox (DSG) Mechatronic - J743- . Refer to appropriate repair manual.
U0415	CAN Communication With ABS Error	• Speed sensor initialization failed • Speed sensor low voltage error failed • Implausible message received	• Time after ignition on 500.0 ms	• 50.0 – 2,100 ms	• 2 DCY	– Check the CAN-Bus terminal resistance. Refer to ⇒ "3.6.4 CAN-Bus Terminal Resistance, Checking", page 159 .

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
U0422	Invalid Data Received From Body Control Module (IPC)	• Ambient temperature value initialization failure.	• Status ambient temperature from instrument cluster no fault • Electrical check ambient temperature sensor no fault	• 2.0 s	• 2 DCY	– Check the Mass Airflow Sensor - G70- . Refer to ⇒ “3.6.22 Mass Airflow Sensor G70 , Checking”, page 193 . – If no fault is found, replace the Instrument Panel Cluster (IPC). Refer to appropriate repair manual.
U0423	Invalid Data Received From Instrument Panel Cluster Control Module	• Implausible CAN message received OR ambient temperature value = 00	• Time after ignition on 500.0 ms	• 3.0 s	• 2 DCY	– Check the Mass Airflow Sensor - G70- . Refer to ⇒ “3.6.22 Mass Airflow Sensor G70 , Checking”, page 193 .
U0447	Lost Communication With Gateway	• CAN message implausible	• Time after ignition on 500.0 ms	• 300.0 ms	• 2 DCY	– Check the CAN-Bus terminal resistance. Refer to ⇒ “3.6.4 CAN-Bus Terminal Resistance, Checking”, page 159 .
U102E	Fan identification sensor Implausible signal	• LIN message incorrect		• 0.5 s	• 2 DCY	– Check the LIN-Bus terminal resistance. Refer to appropriate repair manual.
U102F	Fan identification sensor No Communication	• LIN communication time out		• 0.5 s	• 2 DCY	– Check the LIN-Bus terminal resistance. Refer to appropriate repair manual.

DTC	Error Message	Malfunction Criteria and Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	MIL Illumination	Component Diagnostic Procedure
U1030	Local data bus Electrical malfunction	• LIN communication not active		• 0.5 s	• 2 DCY	– Check the LIN-Bus terminal resistance. Refer to appropriate repair manual.

3.5 Transmission DTC Tables

◆ ⇒ “3.5.1 Transmission Mechatronic , DSG 6-spd 02E”, page 123

3.5.1 Transmission Mechatronic , DSG 6-spd 02E

DQ-250 6F 02E							
DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P0219	Engine Overspeed Condition	• signal range check	• rotational speed of gearbox input shaft exceed a maximum value	• rotational speed> 12000 rpm	• terminal 15 voltage > 4 V for more than 500 ms	• 500 ms	• 2 driving cycles
P0501	Vehicle Speed Sensor "A" Circuit Range/ Performance	• plausibility check	• calculate the speed of input shaft with the gear ratio of engaged gear on input shaft and the output shaft speed. compare the calculated speed with measured speed of input shaft	• speed difference magnitude >330 rpm (output speed = 500rpm)… 100 rpm (output speed>=2000 rpm)	• gear on input shaft engaged • no valid CAN output speed information • output speed > 25 rpm OR speed of input shaft > 1000 rpm • terminal 15 voltage >4 V for more than 500 ms • battery voltage >9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 300 ms	• 2 driving cycles
P0701	Transmission Control System Range/ Performance	• signal range check	• travel sensor voltage gearshift fork 1/3 out of plausibility range	• voltage < 100 mV OR • voltage > 4900mV		• 300 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
			• travel sensor voltage gearshift fork 2/4 out of plausibility range				
			• travel sensor voltage gearshift fork 5/N out of plausibility range				
			• travel sensor voltage gearshift fork 6/R out of plausibility range				
P0702	Transmission Control System Electrical	• plausibility check	• In spite of cut off Common High-side Switch 1 a measurable current. In spite of turned on Common High-side Switch 1 no current measurable.	• CHS1 cut off and CHS1-Current> 40 mA CHS1 turned on and CHS1-Current< 200 mA	• one-time after reset • terminal 15 voltage < 18 V • no short-circuit current check failure of CHS1 • common high-side switch 1 voltage >9.2V • gearbox subsystem 1 active • common high-side switches not deactivated by module 2	• 300 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
			• In spite of cut off Common High-side Switch 2 a measurable current. In spite of turned on Common High-side Switch 2 no current measurable.	• CHS2 cut off and CHS2-Current> 40 mA CHS2 turned on and CHS2-Current< 200 mA	• one-time after reset • terminal 15 voltage < 18 V • no short-circuit current check failure of CHS2 • common high-side switch 2 voltage >9.2V • gearbox subsystem 2 active • common high-side switches not deactivated by module 2		
			• In spite of cut off Common High-side Switch 3 a measurable current. In spite of turned on Common High-side Switch 3no current measurable.	• CHS3 cut off and CHS3-Current> 40 mA CHS3 turned on and CHS3-Current< 200 mA	• one-time after reset • terminal 15 voltage < 18 V • no short-circuit current check failure of CHS3 and main pressure solenoid valve • common high-side switch 1 and 2 voltage >9.2V • common high-side switches not deactivated by module 2		

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0717	Input/Turbine Shaft Speed Sensor "A" Circuit No Signal	• plausibility check	• calculate the speed of input shaft 1 with the gear ratio of engaged gear on input shaft 1 and the output shaft speed. compare the calculated speed with measured speed of input shaft 1	• speed difference magnitude> 330 rpm (output speed = 500rpm)… 100 rpm (output speed>=2000 rpm)	• gear engaged on input shaft 1 • valid CAN output speed information • speed of input shaft 1 < 25 rpm • output speed > 25 rpm • terminal 15 voltage >4 V for more than 500 ms • battery voltage >9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 900 ms	• 2 driving cycles
			• calculate the speed of input shaft 2 with the gear ratio of engaged gear on input shaft 2 and the output shaft speed. compare the calculated speed with measured speed of input shaft 2		• gear engaged on input shaft 2 • valid CAN output speed information • speed of input shaft 2 < 25 rpm • output speed > 25 rpm • terminal 15 voltage >4 V for more than 500 ms • battery voltage >9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms		

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0729	Gear 6 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage sixth gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 2	• integral > 125	• no slipping point adaptation of clutch 2 • multiplexer position = 0 • control gearshift fork valve 3 >= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 2	• 2 driving cycles
P0731	Gear 1 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage first gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 1	• integral > 125	• no slipping point adaptation of clutch 1 • multiplexer position = 0 • control gearshift fork valve 1 >= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 1	• 2 driving cycles

DQ-250 6F 02E							
DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P0732	Gear 2 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage second gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 2	• integral > 125	• no slipping point adaptation of clutch 2 • multiplexer position = 1 • control gearshift fork valve 3>= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 2	• 2 driving cycles
P0733	Gear 3 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage third gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 1	• integral > 125	• no slipping point adaptation of clutch 1 • multiplexer position = 0 • control gearshift fork valve 2 >= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 1	• 2 driving cycles

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0734	Gear 4 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage fourth gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 2	• integral > 125	• no slipping point adaptation of clutch 2 • multiplexer position = 1 • control gearshift fork valve 4 >= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 2	• 2 driving cycles
P0735	Gear 5 Incorrect Ratio	• synchronizing detection while the gearshift fork was controlled to engage fifth gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 1	• integral > 125	• no slipping point adaptation of clutch 1 • multiplexer position = 1 • control gearshift fork valve 1>= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• synchronizing slip, duty factor of safety valve 1	• 2 driving cycles

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0736	Reverse Incorrect Ratio	• unable to disengage the reverse gear	• gearshift fork of reverse gear stays in shifted position in spite of control to disengage	• gearshift fork position < synchronizing point reverse gear - 10% synchronizing point measured by a basic adjustment (reverse gear stays in shifted position) control gearshift fork	• control safety valve 2 (ON) >= 20% • multiplexer position = 0 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles
		• synchronizing detection while the gearshift fork was controlled to engage reverse gear	• integral that corresponds to the energy flux in the synchronization exceeds a maximum value. The integral calculation depends on synchronizing slip and duty factor of the safety valve 2	• integral > 125	• no slipping point adaptation of clutch 1 • multiplexer position = 0 • control gearshift fork valve 4 >= 5% • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms		

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0746	Pressure Control Solenoid "A" Performance/ Stuck Off	• pressure integral monitoring	• integral of actual pressure minus desired pressure minus drain exceeds a maximum value	• pressure integral>= 0,1 bar*s	• desired pressure <= adapted clutch slipping point + 1 bar • standing vehicle with accelerator pedal < 0.1% • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles
		• open-circuit check	• desired valve current of clutch 1 exceeds a threshold simultaneous the actual valve current is smaller than a second threshold	• desired current> 350 mA actual current< 50 mA	• common high-side switch 1 on, not defect and voltage > 9.2 V • gearbox subsystem 1 active • common high-side switches not deactivated by module 2 • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm		

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0747	Pressure Control Solenoid "A" Stuck On	• pressure buildup monitoring	• the number of successive pressure buildup failure of clutch 1 reaches a maximum value	• counter > 2	• engaged gear on input shaft 1 • desired pressure >adapted clutch slipping point – 0.2 bar • output speed < 200 rpm • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 0 ms	• 2 driving cycles
		• short-circuit current check	• comparison of actual valve current with desired valve current of clutch 1	• actual current>desired current and (actual current- desired current)> 200 mA for more than 200 ms	• common high-side switch 1 on, not defect and voltage > 9.2 V • gearbox subsystem 1 active • common high-side switches not deactivated by module 2 • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 200 ms	

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0751	Shift Solenoid "A" Performance/ Stuck Off	• open-circuit check	• Comparison of residual current of gearbox subsystem 1 (total current at common high-side switch 1 – actual current of clutch 1) at switching point of control gearshift fork valve 1 with residual current at permanent control of control gearshift fork valve 1	• difference of residual current<= 200 mA (supply voltage at common high-side 1=7 V) .. 450 mA (supply voltage at common high-side 1=13 V)	• common high-side switch 1 on, not defect and voltage > 9.2 V • gearbox subsystem 1 active • common high-side switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor change of safety valve 1 (control of safety valve 1 is stable) <= 5% • duty factor change of gearshift fork valve 2 (control of gearshift fork valve 2 is stable) <= 5% • y factor change of safety valve 2 > 70% • control of safety valve 2 is stable >= 50 ms • duty factor change of gearshift > 500 rpm	• 300 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P0756	Shift Solenoid "B" Performance/ Stuck Off	• open-circuit check	• Comparison of residual current of gearbox subsystem 1 (total current at common high-side switch 1 – actual current of clutch 1) at switching point of control gearshift fork valve 2 with residual current at permanent control of control gearshift fork valve 2	• difference of residual current<= 200 mA (supply voltage at common high-side 1=7 V) .. 450 mA (supply voltage at common high-side 1=13 V)	• common high-side switch 1 on, not defect and voltage > 9.2 V • gearbox subsystem 1 active • common high-side switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor change of safety valve 1 (control of safety valve 1 is stable) <= 5% • duty factor change of gearshift fork valve 1 (control of gearshift fork valve 1 is stable) <= 5% • duty factor of control gearshift fork valve 2 > 70% and steady state time >= 50ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0761	Shift Solenoid "C" Performance/ Stuck Off	• open-circuit check	• Comparison of residual current of gearbox subsystem 2 (total current at common high-side switch 2 – actual current of clutch 2) at switching point of control gearshift fork valve 3 with residual current at permanent control of control gearshift fork valve 3	• difference of residual current<= 200 mA (supply voltage at common high-side 2=7 V) .. 450 mA (supply voltage at common high-side 2=13 V)	• common high-side switch 2 on, not defect and voltage > 9.2 V • gearbox subsystem 2 active • common high-side switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor change of safety valve 2 <= 5% (control of safety valve 2 is stable) • duty factor change of gearshift fork valve 4 <= 5% (control of gearshift fork valve 4 is stable) • duty factor of control gearshift fork valve 3 > 70% and steady state time >= 50 ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P0766	Shift Solenoid "D" Performance/ Stuck Off	• open-circuit check	• Comparison of residual current of gearbox subsystem 2 (total current at common high-side switch 2 – actual current of clutch 2) at switching point of control gearshift fork valve 4 with residual current at permanent control of control gearshift fork valve 4	• difference of residual current<= 200 mA (supply voltage at common high-side 2=7 V) .. 450 mA (supply voltage at common high-side 2=13 V)	• common high-side switch 2 on, not defect and voltage > 9.2 V • gearbox subsystem 2 active • common high-side switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor change of safety valve 2 <= 5% (control of safety valve 2 is stable) • duty factor change of gearshift fork valve 3 <= 5% (control of gearshift fork valve 3 is stable) • duty factor of control gearshift fork valve 4 > 70% and steady state time >= 50 ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0771	Shift Solenoid "E" Performance/ Stuck Off	• open-circuit check	• Comparison of residual current of central control (total current at common high-side switch 3 – actual current of main pressure valve and cooling oil valve) at switching point of multiplexer valve with residual current at permanent control of multiplexer valve	• difference of residual current <= 150 mA (maximum of supply voltage at common high-side 1,2 and terminal 15 =7 V) .. 300 mA (maximum of supply voltage at common high-side 1,2 and terminal 15 =13 V)	• common high-side switch 3 on and not defect • no short-circuit current check failure of main pressure solenoid valve • common high-side switch 1 and 2 voltage > 9.2 V • common high-side switches not deactivated by module 2 • change of supply voltage < 1 V • multiplexer valve is controled and steady state time >= 50 ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm		
P0776	Pressure Control Solenoid "B" Performance/ Stuck Off	• pressure integral monitoring	• integral of actual pressure minus desired pressure minus drain exceeds a maximum value	• pressure integral >= 0,1 bar*s	• desired pressure <= adapted clutch slipping point + 1 bar • standing vehicle with accelerator pedal < 0.1% • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
		• open-circuit check	• desired valve current of clutch 2 exceeds a threshold simultaneous the actual valve current is smaller than a second threshold	• desired current> 350 mA actual current< 50 mA	• common high-side switch 2 on, not defect and voltage > 9.2 V • gearbox subsystem 2 active • common high-side switches not deactivated by module 2 • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm		
P0777	Pressure Control Solenoid "B" Stuck On	• pressure buildup monitoring	• the number of successive pressure buildup failure of clutch 2 reaches a maximum value	• counter > 2	• engaged gear on input shaft 2 • desired pressure > adapted clutch slipping point – 0.2 bar • output speed < 200 rpm • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 0 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
		• short-circuit current check	• comparison of actual valve current with desired valve current of clutch 2	• actual current >desired current and (actual current-desired current) > 200 mA for more than 200 ms	• common high-side switch 2 on, not defect and voltage > 9.2 V • gearbox subsystem 2 active • common high-side switches not deactivated by module 2 • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 200 ms	
P0781	1-2 Shift	• unable to disengage the first gear	• gearshift fork of first gear stays in shifted position in spite of control to disengage	• gearshift fork position > synchronizing point first gear + 10% synchronizing point measured by a basic adjustment (first gear stays in shifted position) control gearshift fork valve 2 >= 5%	• control safety valve 1 (ON) >= 20% • multiplexer position = 0 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P0782	2-3 Shift	• unable to disengage the second gear	• gearshift fork of second gear stays in shifted position in spite of control to disengage	• gearshift fork position < synchronizing point second gear - 10% synchronizing point measured by a basic adjustment (second gear stays in shifted position) control gearshift fork valve 4 >= 5%	• control safety valve 1 (ON) >= 20% • multiplexer position = 1 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles
P0783	3-4 Shift	• unable to disengage the third gear	• gearshift fork of third gear stays in shifted position in spite of control to disengage	• gearshift fork position < synchronizing point third gear - 10% synchronizing point measured by a basic adjustment (third gear stays in shifted position) control gearshift fork valve 1 >= 5%	• control safety valve 1 (ON) >= 20% • multiplexer position = 0 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0784	4-5 Shift	• unable to disengage the fourth gear	• gearshift fork of fourth gear stays in shifted position in spite of control to disengage	• gearshift fork position > synchronizing point fourth gear + 10% synchronizing point measured by a basic adjustment (fourth gear stays in shifted position) control gearshift fork valve 3 >= 5%	• control safety valve 2 (ON) >= 20% • multiplexer position = 1 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles
P0791	Intermediate Shaft Speed Sensor "A" Circuit	• signal range check	• rotational speed of input shaft 1 exceed a maximum value OR • rotational speed of input shaft 2 exceed a maximum value	• rotational speed > 12000 rpm	• terminal 15 voltage > 4 V for more than 500 ms	• 100 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P0797	Pressure Control Solenoid "C" Stuck On	• short-circuit current check	• comparison of actual valve current with desired valve current of main pressure solenoid valve	• actual current>desired current and (actual current- desired current) > 200 mA for more than 300 ms	• common high-side switch 3 on and not defect • common high-side switch 1 and 2 voltage > 9.2 V • common high-side switches not deactivated by module 2 • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles
P0829	5-6 Shift	• unable to disengage the fifth gear	• gearshift fork of fifth gear stays in shifted position in spite of control to disengage	• gearshift fork position > synchronizing point fifth gear + 10% synchronizing point measured by a basic adjustment (fifth gear stays in shifted position) control gearshift fork valve 2 >= 5%	• control safety valve 1 (ON) >= 20% • multiplexer position = 1 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 6000 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
		• unable to disengage the sixth gear	• gearshift fork of sixth gear stays in shifted position in spite of control to disengage	• gearshift fork position > synchronizing point sixth gear + 10% synchronizing point measured by a basic adjustment (sixth gear stays in shifted position) control gearshift fork valve 4 >= 5%	• control safety valve 2 (ON) >= 20% • multiplexer position = 0 • desired main pressure > 2 bar • no main pressure loss • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms		
P0840	Transmission Fluid Pressure Sensor/ Switch "A" Circuit	• signal range check	• pressure sensor voltage clutch 1 out of plausibility range	• voltage < 100 mV OR • voltage > 4900 mV		• 300 ms	• 2 driving cycles
P0841	Transmission Fluid Pressure Sensor/ Switch "A" Circuit Range/ Performance	• overpressure monitoring	• hydraulic pressure of clutch 1 exceeds a maximum value	• pressure>= 15.5 bar	• signal range check is correct • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 1000 ms	• 2 driving cycles
P0845	Transmission Fluid Pressure Sensor/ Switch "B" Circuit	• pressure sensor voltage clutch 2 out of plausibility range	• pressure sensor voltage clutch 1 out of plausibility range	• voltage < 100 mV OR • voltage > 4900 mV		• 300 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
P0846	Transmission Fluid Pressure Sensor/ Switch "B" Circuit Range/ Performance	• overpressure monitoring	• hydraulic pressure of clutch 2 exceeds a maximum value	• pressure >= 15.5 bar	• signal range check is correct • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 80 ms	• 2 driving cycles
P0864	TCM Communication Circuit Range/ Performance	• buss off detection of the microcontroller			• terminal 15 voltage > 9 V for more than 500 ms • > 500 ms after reset	• 1000 ms	• 2 driving cycles
P0890	TCM Power Relay Sense Circuit Low	• short-circuit current check	• Detection by hardware circuit	• current > 8.5 A	• terminal 15 voltage > 4 V for more than 500 ms	• 200 ms	• 2 driving cycles
P0914	Gear Shift Position Circuit	• time out detection of the question and answer diagnosis	• if time out of the question and answer diagnosis is detected increment an event counter	• time out threshold > 100 ms	• gear message for selector lever is transmittable and selector lever message is receivable • no failure of selector lever CAN messages • time after Reset > 100 ms • terminal 15 voltage > 4 V for more than 500 ms	• 300 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
		• plausibility check of selector lever	• selector lever position is not equal to negation of the inverse selector lever position OR • selector lever position equals initialization value OR • selector lever position equals error value OR • selector lever position is equal to negation of the inverse selector lever position but no valid position	• selector lever position == Position 1 or Position 2 or Position 3 or Position 4 or Position L	• no bus off error • no error failure of all CAN messages • no failure of selector lever CAN messages • time after Reset > 1100 ms • terminal 15 voltage > 9 V for more than 1100 ms	• 1000 ms	
		• question and answer diagnosis	• failure of question and answer diagnosis			• 1500 ms	
P0919	Gear Shift Position Control Error	• evaluation the error signal of selector lever CAN message	• error flag of not determinable selector lever position is set		• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 20 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
		• validity check of selector lever position	• if the selector lever position is equal to negation of the inverse selector lever position but is not valid (position == L, P4, P3, P2, or P1) AND • is not in error state (position != error) AND • initialization value with the initialization flag not set then increment an event counter		• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms		
		• error detection of the question and answer diagnosis	• if the answer of the diagnosis is wrong an event counter is incremented		• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms	• 100 ms	

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
		• plausibility check of selector lever position	• if the selector lever position is not equal to negation of the inverse selector lever position OR • selector lever position equals initialization value but the initialization flag is not set OR • selector lever position equals error value then increment an event counter		• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms • battery voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 400 ms	
P0929	Gear Shift Lock Solenoid/ Actuator Control Circuit "A" Range/ Performance	• validity check of shiftlock position signal	• if the shiftlock position signal is not valid (position != error, deactive, active or init) increment an event counter		• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms	• 20 ms	• 2 driving cycles
P2711	Unexpected Mechanical Gear Disengagement	• unable to engage a gear on shaft 1	• the number of successive engagements of the same gear on shaft 1 exceeds a maximum value	• counter>=6	• battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms	• 0 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
		• unable to engage a gear on shaft 2	• the number of successive engagements of the same gear on shaft 2 exceeds a maximum value				
		• detect disengagement of gears on shaft 1 without control	• In spite of a constant desired gear disengagement counter exceeds a maximum value	• counter >3	• battery voltage > 9 V for more than 500 ms • engine speed > 600 rpm for more than 500 ms • output speed >= 12 rpm		
		• detect disengagement of gears on shaft 2 without control	• In spite of a constant desired gear disengagement counter exceeds a maximum value				

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P2723	Pressure Control Solenoid "E" Performance/ Stuck Off	• open-circuit check	• residual current of gearbox subsystem 1 (total current at common high-side switch 1 – actual current of clutch 1) is smaller than a minimum value	• residual current <= 150 mA (supply voltage at common high-side 1=7 V) .. 300 mA (supply voltage at common high-side 1=13 V)	• common high-side switch 1 on, not defect and voltage > 9.2 V • gearbox subsystem 1 active • common high-side switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor of control gearshift fork valve 1 and 2 <= 10 % • duty factor of safety valve 1 >= 53% and steady state time >= 50 ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
P2732	Pressure Control Solenoid "F" Performance/ Stuck Off	• open-circuit check	• residual current of gearbox subsystem 2 (total current at common high-side switch 2 – actual current of clutch 2) is smaller than a minimum value	• residual current <= 150 mA (supply voltage at common high-side 2=7 V) .. 300 mA (supply voltage at common high-side 2=13 V)	• common high-side switch 2 on, not defect and voltage > 9.2 V • gearbox subsystem 2 active • common high-side switches not deactivated by module 2 • change of supply voltage < 1 V • duty factor of control gearshift fork valve 3 and <= 10 % • duty factor of safety valve 2 >= 53% and steady state time >= 50 ms • terminal 15 voltage > 9 V for more than 500 ms • engine speed > 500 rpm	• 300 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	Fault Code Description	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters with Enable Conditions	Monitoring Time Length	Frequency of checks, MIL Illum
U0100	Lost Communication With ECM/ PCM "A"	• Timeout Check	• failure of all CAN engine messages	• time-out for more than 490 ms	• no bus off error • no error failure of all CAN messages • terminal 15 voltage > 9 V for more than 500 ms • >500 ms after reset	• 490 ms	• 2 driving cycles

DQ-250 6F 02E							
DTC	**Fault Code Description**	**Monitor Strategy Description**	**Malfunction Criteria**	**Threshold Value**	**Secondary Parameters with Enable Conditions**	**Monitoring Time Length**	**Frequency of checks, MIL Illum**
			• failure of one or more CAN engine messages (but not all CAN engine messages)	• time-out for more than 1010 ms	• no bus off error • no error failure of all CAN messages • no error failure of all CAN engine messages • terminal 15 voltage > 9 V for more than 500 ms • >500 ms after reset	• 1010 ms	
			• failure of all CAN messages but gearbox is still in position to send	• time-out for more than 2080 ms	• terminal 15 voltage > 9 V for more than 500 ms • >500 ms after reset	• 2080 ms	
U0103	Lost Communication With Gear Shift Control Module "A"	• Timeout Check	• failure of selector lever CAN messages	• time-out for more than 490 ms	• kein Bus off Fehler no bus off error • no error failure of all CAN messages • terminal 15 voltage > 9 V for more than 500 ms, >500 ms after reset	• 490 ms	• 2 driving cycles
U0404	Invalid Data Received From Gear Shift Control Module "A"	• evaluation of selector lever CAN message counter	• if the value of message counter is permanent constant or change exceeds a threshold increment an event counter	• maximum change of message counter > 5	• no failure of selector lever CAN messages • terminal 15 voltage > 4 V for more than 500 ms	• 50 ms	• 2 driving cycles

3.6 Diagnostic Procedures

- ⇒ “3.6.27 Secondary Air Injection Pump Relay J299 / Secondary Air Injection Pump Motor V101 , Checking”, page 206
- ⇒ “3.6.28 Secondary Air Injection Sensor 1 G609 , Checking”, page 208
- ⇒ “3.6.29 Secondary Air Injection Solenoid Valve N112 , Checking”, page 210
- ⇒ “3.6.30 Three Way Catalytic Converter (TWC), Checking”, page 212
- ⇒ “3.6.31 Throttle Valve Control Module GX3 , Checking”, page 213
- ⇒ “3.6.32 Turbocharger Recirculation Valve N249 , Checking”, page 216
- ⇒ “3.6.33 Vehicle Speed Signal, Checking”, page 218
- ⇒ “3.6.34 Wastegate Bypass Regulator Valve N75 , Checking”, page 220

3.6.1 Accelerator Pedal Module - GX2- , Checking

General Description

The Accelerator Pedal Position Sensor - G79- and Accelerator Pedal Position Sensor 2 - G185- are combined in one component and integrated into the Accelerator Pedal Module - GX2- . They are used to detect the position of the accelerator pedal throughout the entire adjustment range. The Engine Control Module - J623- detects the driver’s request from these signals and uses them to calculate the injection quantity and EPC Throttle valve operation.

The Accelerator Pedal Module - GX2- contains the following components:

- Accelerator Pedal Position Sensor - G79-
- Accelerator Pedal Position Sensor 2 - G185-

The Accelerator Pedal Module - GX2- components cannot be serviced separately, it must be serviced as a unit.

Special tools and workshop equipment required

- Multimeter.
- Wiring Diagram.
- Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions: ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions: ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ "3.1 Preliminary Check", page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 154 . – NO: ◆ GATHER more information from customer about the complaint.
2	• CONNECT: Scan Tool. • IGNITION: ON. • CHECK: Throttle valve position closed: • SPECIFIED VALUE: 3 – 25%. • DEPRESS: Accelerator pedal slowly to WOT while observing the percentage display. The percentage display must increase uniformly. • CHECK: Throttle valve position at WOT. • IGNITION: OFF. • SPECIFIED VALUE: 84 – 97%. – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 154 . – NO: ◆ GO TO: Step 4 ⇒ page 154 .
3	• Condition may be intermittent. • PERFORM: Visual Inspection of wiring and component. • CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. • REPAIR: Faulty wiring or connector.	◆ GO TO: Step 7 ⇒ page 155 .
4	• DISCONNECT: Accelerator Pedal Module - GX2- harness connector. • IGNITION: ON. • CHECK: Accelerator Pedal Module - GX2- harness connector terminals 1 to 5 and 2 to 3 for voltage. • IGNITION: OFF. • SPECIFIED VALUE: About 5.0 V. – Were Values obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 154 . – NO: ◆ GO TO: Step 6 ⇒ page 155 .
5	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Accelerator Pedal Module - GX2- harness connector terminal 4 to the Engine Control Module - J623- harness connector T94 / 83 for resistance. • CHECK: Accelerator Pedal Module - GX2- harness connector terminal 6 to the Engine Control Module - J623- harness connector T94 / 61 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ REPLACE: Accelerator Pedal Module - GX2- . Refer to appropriate repair manual. ◆ GO TO: Step 7 ⇒ page 155 – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 155 .

Step	Procedure	Result / Action to Take
6	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Accelerator Pedal Module - GX2- harness connector terminal 1 to the Engine Control Module - J623- harness connector T94 / 81 for resistance. • CHECK: Accelerator Pedal Module - GX2- harness connector terminal 2 to the Engine Control Module - J623- harness connector T94 / 82 for resistance. • CHECK: Accelerator Pedal Module - GX2- harness connector terminal 3 to the Engine Control Module - J623- harness connector T94 / 35 for resistance. • CHECK: Accelerator Pedal Module - GX2- harness connector terminal 5 to the Engine Control Module - J623- harness connector T94 / 11 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 7 ⇒ page 155 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 155 .
7	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21. ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC's. ◆ If no DTC's return the repair is complete. ◆ Return vehicle to customer.

3.6.2 Camshaft Adjustment Valve 1 - N205- , Checking

General Description

The camshaft's task is to operate the valves at the right time and in the right order to control the charge cycle. Camshaft adjustment using the Camshaft Adjustment Valve 1 - N205- varies the opening times of the valves to suit all operating conditions. This ensures ideal charge cycles within a wide range of engine speeds and loads. Fuel consumption and pollutant emissions are reduced, torque and smoothness increased. In engines with a double overhead camshaft the size and positioning of the valve

opening overlap can be influenced, enhancing characteristics in full-load and part-load operation. In continuous camshaft adjustment, the adjustment is infinitely variable within specific parameters.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 156 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Camshaft Adjustment Valve 1 - N205- harness connector. • CHECK: Camshaft Adjustment Valve 1 - N205- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 5 to 20 Ω (+/- 3 Ω at approx. 20° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 156 . – NO: ♦ REPLACE: Camshaft Adjustment Valve 1 - N205- . Refer to appropriate repair manual. ♦ GO TO: Step 5 ⇒ page 157 .
3	• IGNITION: ON. • CHECK: Camshaft Adjustment Valve 1 - N205- harness connector terminal 1 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ♦ GO TO: Step 4 ⇒ page 157 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 157 .

Step	Procedure	Result / Action to Take
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Camshaft Adjustment Valve 1 - N205- harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / 5 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 157 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 157 .
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC's. ◆ If no DTC's return the repair is complete. ◆ Return vehicle to customer.

3.6.3 Camshaft Position Sensor - G40- , Checking

General Description

Using the signal from the Camshaft Position Sensor - G40- , the precise position of the camshaft relative to the crankshaft is determined very quickly when the engine is started. Used in combination with the signal from the Engine Speed Sensor - G28- , the signal from the Camshaft Position Sensor - G40- allows the Engine Control Module - J623- to detect which cylinder is at TDC. The fuel can be injected into the corresponding cylinder and ignited.

Special tools and workshop equipment required

- ◆ Multimeter.
- ◆ Wiring Diagram.
- ◆ Scan Tool.

Test requirements

- Fuses OK.

- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions: ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions: ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 158 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Camshaft Position Sensor - G40- harness connector. • IGNITION: ON. • CHECK: Camshaft Position Sensor - G40- harness connector terminals 1 to 3 for voltage. • IGNITION: OFF. • SPECIFIED VALUE: About 5.0 V. – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 158 . – NO: ◆ GO TO: Step 4 ⇒ page 158 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Camshaft Position Sensor - G40- harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / 53 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ REPLACE: Camshaft Position Sensor - G40- . Refer to appropriate repair manual. ◆ GO TO: Step 5 ⇒ page 159 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 159 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Camshaft Position Sensor - G40- harness connector terminal 1 to the Engine Control Module - J623- harness connector T60 / 29 for resistance. • CHECK: Camshaft Position Sensor - G40- harness connector terminal 3 to the Engine Control Module - J623- harness connector T60 / 8 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 159 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 159 .

Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.4 CAN-Bus Terminal Resistance, Checking

General Description

The Engine Control Module - J623- communicates with other CAN-Bus capable control modules.

The control modules are connected by two data bus wires which are twisted together (CAN_High and CAN_Low), and exchange information (messages). Missing information on the CAN-bus is recognized as a malfunction by the Engine Control Module - J623- and the other control modules connected to the CAN-bus.

Trouble-free operation of the CAN-Bus requires that it have a terminal resistance. This central terminal resistance is located in the Engine Control Module - J623- .

Special tools and workshop equipment required

♦ Multimeter.

♦ Wiring Diagram.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Manual Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Observe all safety precautions: ⇒ "1.1 Safety Precautions", page 2 .

- View clean working conditions: ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 160 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Data Bus On Board Diagnostic Interface - J533- harness connector. • The Engine Control Module - J623- must remain connected for the following step. • CHECK: Data Bus On Board Diagnostic Interface - J533- harness connector terminals 6 to 16 for resistance. • SPECIFIED VALUE: 60 – 72 Ω (at approx. 20° C). – Was Value obtained?	– YES: ♦ CONDITION: May be intermittent. ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 4 ⇒ page 161 . – NO: ♦ GO TO: Step 3 ⇒ page 160 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Data Bus On Board Diagnostic Interface - J533- harness connector terminal 6 to the Engine Control Module - J623- harness connector T94 / 67 for resistance. • CHECK: Data Bus On Board Diagnostic Interface - J533- harness connector terminal 16 to the Engine Control Module - J623- harness connector T94 / 68 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ GO TO Step 4 ⇒ page 161 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 4 ⇒ page 161 .

Step	Procedure	Result / Action to Take
4	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Data Bus On Board Diagnostic Interface - J533- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: Data Bus On Board Diagnostic Interface - J533- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.5 CAN-Bus Terminal Resistance, Powertrain, Checking

General Description

The Engine Control Module - J623- communicates with all databus capable control modules via a CAN databus.

These databus capable control modules are connected via two data bus wires which are twisted together (CAN_High and CAN_Low), and exchange information (messages). Missing information on the databus is recognized as a malfunction and stored.

Trouble-free operation of the CAN-bus requires that it have a terminal resistance. The central terminal resistor is located in the Engine Control Module - J623- .

Special tools and workshop equipment required

♦ Multimeter.

♦ Wiring Diagram.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".

- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 162 . – NO: ♦ GATHER more information from customer about the complaint.
2	• The Engine Control Module - J623- must remain connected for the following step. The central terminal resistor is located in the Engine Control Module - J623- . • IGNITION: OFF. • REMOVE: DSG Transmission Mechatronic - J743- . Refer to appropriate repair manual. • CHECK: DSG Transmission Mechatronic - J743- harness connector T20m / 10 to 15 for resistance. • SPECIFIED VALUE: 60 – 72 Ω (at approx. 20° C). – Was Value obtained?	– YES: ♦ CONDITION: May be intermittent. ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 4 ⇒ page 163 . – NO: ♦ GO TO: Step 3 ⇒ page 162 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: CAN bus circuit between the DSG Transmission Mechatronic - J743- harness connector T20m / 15 and the Engine Control Module - J623- harness connector T94 / 67 for resistance. • CHECK: CAN bus circuit between the DSG Transmission Mechatronic - J743- harness connector T20m / 10 and the Engine Control Module - J623- harness connector T94 / 68 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ GO TO: Step 4 ⇒ page 163 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 4 ⇒ page 163 .

Step	Procedure	Result / Action to Take
4	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: DSG Transmission Mechatronic - J743- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. ♦ If all electrical connections are OK: ♦ REPLACE: DSG Transmission Mechatronic - J743- . Refer to appropriate repair manual. ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.6 Charge Air Pressure Sensor - G31- , Checking

General Description

The Charge Air Pressure Sensor - G31- is located in the inlet to the intake manifold. The Engine Control Module - J623- uses the sensor's signal to regulate the charge air pressure. There is no substitute function in the event of signal failure. Charge air pressure regulation is shut off, leading to a significant reduction in engine output.

Special tools and workshop equipment required

♦ Multimeter.

♦ Wiring Diagram.

♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Manual Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.

- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 164 . – NO: ◆ GATHER more information from customer about the complaint.
2	• DISCONNECT: Charge Air Pressure Sensor - G31- harness connector. • IGNITION: ON. • CHECK: Charge Air Pressure Sensor - G31- harness connector terminals 1 to 3 for voltage. • IGNITION: OFF. • SPECIFIED VALUE: About 5.0 V. – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 164 . – NO: ◆ GO TO: Step 4 ⇒ page 164 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Charge Air Pressure Sensor - G31- harness connector terminal 4 to the Engine Control Module - J623- harness connector T60 / 39 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ REPLACE: Charge Air Pressure Sensor - G31- . Refer to appropriate repair manual. ◆ GO TO: Step 5 ⇒ page 165 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 165 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Charge Air Pressure Sensor - G31- harness connector terminal 1 to the Engine Control Module - J623- harness connector T60 / 13 for resistance. • CHECK: Charge Air Pressure Sensor - G31- harness connector terminal 3 to the Engine Control Module - J623- harness connector T60 / 27 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 165 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 165 .

Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.7 Coolant Circulation Pump Relay - J151- / After-Run Coolant Pump - V51- , Checking

General Description

The Coolant Circulation Pump Relay - J151- provides the power supply voltage to the After-Run Coolant Pump - V51- is cycled on and off by the Engine Control Module - J623- .

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Man. Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Observe all safety precautions: ⇒ "1.1 Safety Precautions", page 2 .
- View clean working conditions: ⇒ "1.2 Clean Working Conditions", page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 166 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • REMOVE: Coolant Circulation Pump Relay - J151- . Refer to appropriate repair manual. • IGNITION: ON. • CHECK: Coolant Circulation Pump Relay - J151- socket terminals 1.2 and 3.2 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Were Values obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 166 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 167 .
3	• CONNECT: Jumper wire, Coolant Circulation Pump Relay - J151- socket terminals 3.2 and 5.2. • IGNITION: ON. • SPECIFIED VALUE: After-Run Coolant Pump - V51- should be heard running. • IGNITION: OFF. – Was Value obtained?	– YES: ◆ GO TO: Step 6 ⇒ page 167 . – NO: ◆ GO TO: Step 4 ⇒ page 166 .
4	• DISCONNECT: After-Run Coolant Pump - V51- harness connector. • IGNITION: ON. • CHECK: After-Run Coolant Pump - V51- harness connector terminal 1 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 166 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 167 .
5	• CHECK: After-Run Coolant Pump - V51- harness connector terminal 2 to ground for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ REPLACE: After-Run Coolant Pump - V51- . Refer to appropriate repair manual. ◆ GO TO: Step 7 ⇒ page 167 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 167 .

Step	Procedure	Result / Action to Take
6	• REMOVE: Jumper wire, Coolant Circulation Pump Relay - J151- socket terminals 3.2 and 5.2. • REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Coolant Circulation Pump Relay - J151- socket terminal 2.2 to the Engine Control Module - J623- harness connector T94 / 27 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ REPLACE: Coolant Circulation Pump Relay - J151- . Refer to appropriate repair manual. ◆ GO TO: Step 7 ⇒ page 167 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 167 .
7	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC's. ◆ If no DTC's return the repair is complete. ◆ Return vehicle to customer.

3.6.8 Engine Coolant Temperature Sensor - G62- , Checking

General Description

The Engine Coolant Temperature Sensor - G62- sends information about the current coolant temperature to the Engine Control Module - J623- . It uses the coolant temperature as a correction value for calculating the injection quantity.

Special tools and workshop equipment required

◆ Multimeter.

◆ Wiring Diagram.

◆ Scan Tool.

Test requirements

• Fuses OK.

• Battery voltage OK.

- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions:
⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 168 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Engine Coolant Temperature Sensor - G62- harness connector. • CHECK: Engine Coolant Temperature Sensor - G62- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 2,250 Ω (+/- 750 @ approx. 20° C). – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 168 . – NO: ◆ REPLACE: Engine Coolant Temperature Sensor - G62- . Refer to appropriate repair manual. ◆ GO TO: Step 4 ⇒ page 169 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Engine Coolant Temperature Sensor - G62- harness connector terminal 1 to the Engine Control Module - J623- harness connector T60 / 57 for resistance. • CHECK: Engine Coolant Temperature Sensor - G62- harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / 14 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 169 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 4 ⇒ page 169 .

Step	Procedure	Result / Action to Take
4	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC's. ◆ If no DTC's return the repair is complete. ◆ Return vehicle to customer.

3.6.9 Engine Coolant Temperature Sensor On Radiator Outlet - G83-

General Description

The Engine Coolant Temperature Sensor On Radiator Outlet - G83- sends information about the current coolant temperature to the Engine Control Module - J623- . It uses the coolant temperature as a correction value for calculating the injection quantity.

Special tools and workshop equipment required

- ◆ Multimeter.
- ◆ Wiring Diagram.
- ◆ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Manual Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Observe all safety precautions: ⇒ "1.1 Safety Precautions", page 2 .
- View clean working conditions: ⇒ "1.2 Clean Working Conditions", page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 170 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Engine Coolant Temperature Sensor On Radiator Outlet - G83- harness connector. • CHECK: Engine Coolant Temperature Sensor On Radiator Outlet - G83- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 2,250 Ω (+/- 750 Ω @ approx. 20° C). – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 170 . – NO: ◆ REPLACE: Engine Coolant Temperature Sensor On Radiator Outlet - G83- . Refer to appropriate repair manual. ◆ GO TO: Step 4 ⇒ page 170 .
3	• REMOVE: Engine Control Module - J623- Refer to appropriate repair manual. • CHECK: Engine Coolant Temperature Sensor On Radiator Outlet - G83- harness connector terminal 1 to the Engine Control Module - J623- harness connector T94 / 36 for resistance. • CHECK: Engine Coolant Temperature Sensor On Radiator Outlet - G83- harness connector terminal 2 to the Engine Control Module - J623- harness connector T94 / 12 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 170 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 4 ⇒ page 170 .
4	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Clear the DTC’s. Refer to ⇒ “3.3.4 Diagnostic Mode 04 - Erase DTC Memory”, page 21 . ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ “3.2 Readiness Code”, page 14 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC’s. ◆ If no DTC’s return the repair is complete. ◆ Return vehicle to customer.

3.6.10 Engine Speed Sensor - G28- , Checking

General Description

The Engine Speed Sensor - G28- detects rpm and reference marks from a toothed wheel on the crankshaft. Without an engine speed signal, the engine will not start. If the engine speed signal fails while the engine is running, the engine will stop immediately.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 171 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Engine Speed Sensor - G28- harness connector. • REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Engine Speed Sensor - G28- harness connector terminal 1 to the Engine Control Module - J623- harness connector T60 / 51 for resistance. • CHECK: Engine Speed Sensor - G28- harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / 36 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ REMOVE: Engine Speed Sensor - G28- . Refer to appropriate repair manual. ♦ CHECK: Engine Speed Sensor - G28- wheel for proper seating, damage and/or run - out. Refer to appropriate repair manual. ♦ Sensor wheel OK. ♦ REPLACE: Engine Speed Sensor - G28- . Refer to appropriate repair manual. ♦ GO TO: Step 3 ⇒ page 172 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 3 ⇒ page 172 .

Step	Procedure	Result / Action to Take
3	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.11 EVAP Canister Purge Regulator Valve 1 - N80- , Checking

General Description

EVAP system is designed so that the admission of fuel vapors takes place only at idle and at light part-throttle. The EVAP Canister Purge Regulator Valve 1 - N80- is map-activated by the Engine Control Module - J623- to accomplish this task.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Manual Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Observe all safety precautions: ⇒ "1.1 Safety Precautions", page 2 .
- View clean working conditions: ⇒ "1.2 Clean Working Conditions", page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ "3.1 Preliminary Check", page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 173 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: EVAP Canister Purge Regulator Valve 1 - N80- harness connector. • CHECK: EVAP Canister Purge Regulator Valve 1 - N80- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 10 – 35 Ω (@ approx. 20° C). – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 173 . – NO: ◆ REPLACE: EVAP Canister Purge Regulator Valve 1 - N80- . Refer to appropriate repair manual. ◆ GO TO: Step 5 ⇒ page 174 .
3	• IGNITION: ON. • CHECK: EVAP Canister Purge Regulator Valve 1 - N80- harness connector terminal 1 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 173 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 174 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: EVAP Canister Purge Regulator Valve 1 - N80- harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / 35 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 174 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 174 .

Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.12 Fuel Delivery Unit - GX1- / Fuel Pump Control Module - J538- , Checking

General Description

The Engine Control Module - J623- tells the Fuel Pump Control Module - J538- the demand needed for fuel volume and pressure and activates the Transfer Fuel Pump - G6- . The Transfer Fuel Pump - G6- transfers fuel to the rest of the fuel system, where it is monitored by the Engine Control Module - J623- through sensors, and controlled through regulators and/or metering valves.

Special tools and workshop equipment required

♦ Multimeter.

♦ Wiring Diagram.

♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF all electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Man. Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Observe all safety precautions: ⇒ "1.1 Safety Precautions", page 2 .
- View clean working conditions: ⇒ "1.2 Clean Working Conditions", page 3 .

Test Procedure

Note

When the door is opened or the Ignition is turned to the ON position the fuel pump is activated for 2 seconds to build up the pressure in the fuel system.

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 175 . ◆ NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: ON. • LISTEN: Fuel Delivery Unit - GX1- should be heard running for 2 s. • IGNITION: OFF. • SPECIFIED VALUE: Transfer Fuel Pump ON for 2 s. – Was Value obtained?	– YES: ◆ Condition may be intermittent. ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 6 ⇒ page 176 . ◆ NO: ◆ GO TO: Step 3 ⇒ page 175 .
3	• DISCONNECT: Fuel Pump Control Module. - J538- harness connector. • IGNITION: ON. • CHECK: Fuel Pump Control Module - J538- harness connector terminals 6 to 1 and 3 for voltage. • CHECK: Fuel Pump Control Module - J538- harness connector terminal 6 to battery voltage for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Were Values obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 175 . ◆ NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 6 ⇒ page 176 .
4	• RECONNECT: Fuel Pump Control Module - J538- harness connector. • DISCONNECT: Fuel Delivery Unit - GX1- harness connector. • CRANK: Engine. • CHECK: Fuel Delivery Unit - GX1- harness connector terminals 1 to 5 for voltage while engine is cranking. • IGNITION: OFF. • SPECIFIED VALUE: 7 – 11 V. – Was Value obtained?	– YES: ◆ REPLACE: Fuel Delivery Unit - GX1- , Refer to appropriate repair manual. ◆ GO TO: Step 6 ⇒ page 176 . ◆ NO: ◆ GO TO: Step 5 ⇒ page 176 .

Step	Procedure	Result / Action to Take
5	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Fuel Pump Control Module - J538- harness connector terminal 2 to Engine Control Module - J623- harness connector terminal T94 / 30 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ♦ REPLACE: Fuel Pump Control Module - J538- . Refer to appropriate repair manual. ♦ GO TO: Step 6 ⇒ page 176 . ♦ NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 6 ⇒ page 176 .
6	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.13 Fuel Injectors, Checking

General Description

The Fuel Injectors are controlled by the Engine Control Module - J623- and are mounted normally in the cylinder head. The fuel injectors spray high-pressure atomized fuel directly into the combustion chamber.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.
- ♦ LED Test Lamp.

Test requirements

- Fuses OK.

- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions: ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions: ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 177 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Suspect Fuel Injector harness connector. • CHECK: Suspect Fuel Injector component connector terminals 1 to 2 for resistance (refer to appropriate wiring diagram for proper terminal locations). • SPECIFIED VALUE: 0.5 – 15 Ω (@ approx. 20° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 177 . – NO: ♦ REPLACE: Suspect Fuel Injector (s). Refer to appropriate repair manual. ♦ GO TO: Step 4 ⇒ page 178 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Suspect Fuel Injector harness connector terminal 1 to the Engine Control Module - J623- harness connector T60 / xx for resistance (refer to appropriate wiring diagram for proper terminal locations). • CHECK: Suspect Fuel Injector harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / xx for resistance (refer to appropriate wiring diagram for proper terminal locations). • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ REPLACE: Suspect Fuel Injector for a mechanical condition. Refer to appropriate repair manual. ♦ GO TO: Step 4 ⇒ page 178 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 4 ⇒ page 178 .

Step	Procedure	Result / Action to Take
4	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.14 Fuel Pressure Regulator Valve - N276- , Checking

General Description

The Engine Control Module - J623- regulates the Fuel Pressure Regulator Valve - N276- directly at the High Pressure Fuel Pump to control the low pressure valve inside the High Pressure Fuel Pump.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Manual Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Observe all safety precautions: ⇒ "1.1 Safety Precautions", page 2 .
- View clean working conditions: ⇒ "1.2 Clean Working Conditions", page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 179 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Fuel Pressure Regulator Valve - N276- harness connector. • CHECK: Fuel Pressure Regulator Valve - N276- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 1.5 – 11 Ω (@ approx. 20° C). – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 179 . – NO: ◆ REPLACE: Fuel Pressure Regulator Valve - N276- . Refer to appropriate repair manual. ◆ GO TO: Step 5 ⇒ page 180 .
3	• IGNITION: ON. • CHECK: Fuel Pressure Regulator Valve - N276- harness connector terminal 1 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 179 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 180 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Fuel Pressure Regulator Valve - N276- harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / 19 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 180 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 180 .

Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.15 Fuel Pressure Sensor - G247- , Checking

General Description

The Fuel Pressure Sensor - G247- measures the fuel pressure in the high-pressure fuel system. The Engine Control Module - J623- analyzes the signal and regulates the fuel high pressure through the Fuel Pressure Regulator Valve - N276- in the high-pressure pump.

Special tools and workshop equipment required

♦ Multimeter.

♦ Wiring Diagram.

♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Manual Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Observe all safety precautions: ⇒ "1.1 Safety Precautions", page 2 .
- View clean working conditions: ⇒ "1.2 Clean Working Conditions", page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 181 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Fuel Pressure Sensor - G247- harness connector. • IGNITION: ON. • CHECK: Fuel Pressure Sensor - G247- harness connector terminals 1 to 3 for voltage. • IGNITION: OFF. • SPECIFIED VALUE: About 5.0 V. – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 181 . – NO: ◆ GO TO: Step 4 ⇒ page 181 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Fuel Pressure Sensor - G247- harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / 40 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ REPLACE: Fuel Pressure Sensor - G247- . Refer to appropriate repair manual. ◆ GO TO: Step 5 ⇒ page 182 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 182 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Fuel Pressure Sensor - G247- harness connector terminal 1 to the Engine Control Module - J623- harness connector T60 / 13 for resistance. • CHECK: Fuel Pressure Sensor - G247- harness connector terminal 3 to the Engine Control Module - J623- harness connector T60 / 29 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 182 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 182 .

Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ “3.3.4 Diagnostic Mode 04 - Erase DTC Memory”, page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ “3.2 Readiness Code”, page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.16 Ignition Coils With Power Output Stage , Checking

General Description

The ignition coil must transform the relatively low 12 V on-board vehicle voltage to the high ignition voltage required and supply the energy stored in that voltage to the spark plug. The functional principle of the ignition coil is relatively simple. It has a primary winding (small number of turns) and a secondary winding (lots of turns). The turn ratio between the number of primary and secondary winding turns determines the level of the voltage generated at the output. The Ignition Coils With Power Output Stage are plugged directly into the spark plug. This means the ignition energy can be transferred directly to the spark plug with virtually zero power loss.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.
- ♦ LED Test Lamp.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.

- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 183 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Suspect Ignition Coil With Power Output Stage harness connector. • IGNITION: ON. • CHECK: Suspect Ignition Coil With Power Output Stage harness connector terminals 1 to 2 and 4 for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Were Values obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 183 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 184 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Suspect Ignition Coil With Power Output Stage harness connector terminal 3 to the Engine Control Module - J623- harness connector T60 / xx for resistance (refer to appropriate wiring diagram for proper terminal locations). • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 183 . – NO: ◆ NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 184 .
4	• DISCONNECT: All of the Fuel Injectors . Refer to appropriate wiring diagram. • DISCONNECT: Cold Start Injector (If applicable). • CONNECT: Engine Control Module - J623- harness connector. • CONNECT: LED Test Lamp to Suspect Ignition Coil With Power Output Stage harness connector terminals 1 to 3. • CRANK: Engine. • SPECIFIED VALUE: LED Test Lamp should Flicker ON & OFF. – Was Value obtained?	– YES: ◆ REPLACE: Suspect Ignition Coil With Power Output Stage . Refer to appropriate repair manual. ◆ GO TO: Step 5 ⇒ page 184 . – NO: ◆ GO TO: Step 5 ⇒ page 184 .

Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.17 Intake Air Temperature Sensor - G42- , Checking

General Description

The Engine Control Module - J623- uses the Intake Air Temperature Sensor - G42- signal to calculate a correction value for the charge air pressure. Evaluation of the signal gives consideration to the influence of temperature on the density of the charge air.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Manual Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Observe all safety precautions: ⇒ "1.1 Safety Precautions", page 2 .
- View clean working conditions: ⇒ "1.2 Clean Working Conditions", page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 185 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Intake Air Temperature Sensor - G42- harness connector. • CHECK: Intake Air Temperature Sensor - G42- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 1,800 Ω (+/- 750 Ω @ approx. 20° C). – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 185 . – NO: ◆ REPLACE: Intake Air Temperature Sensor - G42- . Refer to appropriate repair manual. ◆ GO TO: Step 4 ⇒ page 185 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Intake Air Temperature Sensor - G42- harness connector terminal 1 to the Engine Control Module - J623- harness connector T60 / 42 for resistance. • CHECK: Intake Air Temperature Sensor - G42- harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / 14 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 185 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 4 ⇒ page 185 .
4	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Clear the DTC’s. Refer to ⇒ “3.3.4 Diagnostic Mode 04 - Erase DTC Memory”, page 21 . ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ “3.2 Readiness Code”, page 14 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC’s. ◆ If no DTC’s return the repair is complete. ◆ Return vehicle to customer.

3.6.18 Intake Manifold Runner Control Valve - N316- , Checking

General Description

The intake manifold runner valve(s) are mounted on a common shaft and actuated by a vacuum cell. The partial vacuum required for actuation is supplied by the Intake Manifold Runner Control Valve - N316- . The Engine Control Module - J623- activates the Intake Manifold Runner Control Valve - N316- on the basis of a characteristic map.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 186 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Intake Manifold Runner Control Valve - N316- harness connector. • CHECK: Intake Manifold Runner Control Valve - N316- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 5 – 35 Ω (@ approx. 20° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 187 . – NO: ♦ REPLACE: Intake Manifold Runner Control Valve - N316- . Refer to appropriate repair manual. ♦ GO TO: Step 5 ⇒ page 187 .

Step	Procedure	Result / Action to Take
3	• IGNITION: ON. • CHECK: Intake Manifold Runner Control Valve - N316- harness connector terminal 1 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 187 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 187 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Intake Manifold Runner Control Valve - N316- harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / 20 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 187 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 187 .
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC's. ◆ If no DTC's return the repair is complete. ◆ Return vehicle to customer.

3.6.19 Intake Manifold Runner Position Sensor - G336- , Checking

General Description

The Intake Manifold Runner Position Sensor - G336- monitors the position of the intake manifold runner flaps. These flaps can be adjusted open or closed to provide longer or shorter intake run-

ners depending on ambient conditions to increase engine efficiency.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 188 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Intake Manifold Runner Position Sensor - G336- harness connector. • IGNITION: ON. • CHECK: Intake Manifold Runner Position Sensor - G336- harness connector terminals 1 to 3 for voltage. • IGNITION: OFF. • SPECIFIED VALUE: About 5.0 V. – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 188 . – NO: ♦ GO TO: Step 4 ⇒ page 189 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Intake Manifold Runner Position Sensor - G336- harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / 59 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ♦ REPLACE: Intake Manifold Runner Position Sensor - G336- . Refer to appropriate repair manual. ♦ GO TO: Step 5 ⇒ page 189 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 189 .

Step	Procedure	Result / Action to Take
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Intake Manifold Runner Position Sensor - G336- harness connector terminal 1 to the Engine Control Module - J623- harness connector T60 / 27 for resistance. • CHECK: Intake Manifold Runner Position Sensor - G336- harness connector terminal 3 to the Engine Control Module - J623- harness connector T60 / 13 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ GO TO: Step 5 ⇒ page 189 . – NO: ♦ NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 189 .
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.20 Knock Sensor 1 - G61- , Checking

General Description

The Knock Sensor 1 - G61- is a tuned accelerometer on the engine which converts engine vibration to an electrical signal. The Engine Control Module - J623- uses this signal to determine the presence of engine knock and to retard spark timing.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.

- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 190 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Knock Sensor 1 - G61- harness connector. • CHECK: Knock Sensor 1 - G61- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 2,250 Ω (+/- 750 @ approx. 20° C). – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 190 . – NO: ◆ REPLACE: Knock Sensor 1 - G61- . Refer to appropriate repair manual. ◆ GO TO: Step 4 ⇒ page 191 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Knock Sensor 1 - G61- harness connector terminal 1 to the Engine Control Module - J623- harness connector T60 / 25 for resistance. • CHECK: Knock Sensor 1 - G61- harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / 10 for resistance. • CHECK: Knock Sensor 1 - G61- harness connector terminal 3 to the Engine Control Module - J623- harness connector T60 / 56 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 191 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 4 ⇒ page 191 .

Step	Procedure	Result / Action to Take
4	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.21 Leak Detection Pump - V144- , Checking

General Description

Whenever the engine is running, vacuum is applied to the Vacuum Switch. This switch applies vacuum to the Upper Chamber of the pump when it receives a ground signal from the Engine Control Module - J623- . This signal is a duty cycle pulse of approximately 40%. When vacuum is applied to the Upper Chamber, fresh air flows in through the One-way Inlet Valve, compressing the spring above the diaphragm. When the Diaphragm begins to rise, the Reed Switch, attached to the Diaphragm Rod, opens. When the Vacuum Switch closes, the vacuum in the Upper Chamber is released. As a result, the spring pushes the Diaphragm down. As the Diaphragm is pushed down, the air in the Lower Chamber is pushed out of the One-way Outlet Valve into the EVAP system. This process continues until the pressure in the EVAP system no longer allows the spring to push the Diaphragm down. With tension on the Diaphragm, the ECM waits for a certain period of time to watch for the Diaphragm to fall. The Reed Switch closing signals that the Diaphragm has fallen to its lowest point. When the Reed Switch closes, the ECM may cycle the LDP to build up system pressure again. The ECM measures the time it takes for the Reed Switch to close once the LDP has stopped running to determine if there is a leak in the system. The slower the Diaphragm falls after the pump stops running, the less air is leaking out of the EVAP system.

Special tools and workshop equipment required

- Multimeter.
- Wiring Diagram.
- Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions: ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions: ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 192 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Leak Detection Pump - V144- harness connector. • IGNITION: ON. • CHECK: Leak Detection Pump - V144- harness connector terminal 3 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 192 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 193 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Leak Detection Pump - V144- harness connector terminal 1 to the Engine Control Module - J623- harness connector T94 / 44 for resistance. • CHECK: Leak Detection Pump - V144- harness connector terminal 2 to the Engine Control Module - J623- harness connector T94 / 49 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ GO TO: Step 4 ⇒ page 192 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 5 ⇒ page 193 .
4	• CONNECT: Leak Detection Pump - V144- harness connector. • CONNECT: Engine Control Module - J623- harness connector T94 / 49 to ground. • CHECK: Leak Detection Pump - V144- for operation. • SPECIFIED VALUE: Leak Detection Pump - V144- should be heard running. – Was Value obtained?	– YES: ♦ GO TO: Step 5 ⇒ page 193 . – NO: ♦ REPLACE: Leak Detection Pump - V144- . Refer to appropriate repair manual. ♦ GO TO: Step 5 ⇒ page 193 .

Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.22 Mass Airflow Sensor - G70- , Checking

General Description

The signal from the Mass Airflow Sensor - G70- is used in the Engine Control Module - J623- to calculate the volumetric efficiency. Based on the volumetric efficiency, and taking into consideration the lambda value and ignition timing, the Engine Control Module - J623- calculates the engine torque.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Manual Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Observe all safety precautions: ⇒ "1.1 Safety Precautions", page 2 .
- View clean working conditions: ⇒ "1.2 Clean Working Conditions", page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ "3.1 Preliminary Check", page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 194 . – NO: ◆ GATHER more information from customer about the complaint.
2	• CONNECT: Scan tool . • START: Engine and let Idle. • CHECK: The air flow quantity of the Mass Air Flow Sensor - G70- . • IGNITION: OFF. • SPECIFIED VALUE: About 2 to 5 g/s. – Was Value obtained?	– YES: ◆ Condition may be intermittent. ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 195 . – NO: ◆ GO TO: Step 3 ⇒ page 194 .
3	• DISCONNECT: Mass Airflow Sensor - G70- harness connector. • IGNITION: ON. • CHECK: Mass Airflow Sensor - G70- harness connector terminal 3 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 194 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 195 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Mass Airflow Sensor - G70- harness connector terminal 1 to the Engine Control Module - J623- harness connector T94 / 23 for resistance. • CHECK: Mass Airflow Sensor - G70- harness connector terminal 2 to the Engine Control Module - J623- harness connector T94 / 65 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ REPLACE: Mass Airflow Sensor - G70- . Refer to appropriate repair manual. ◆ GO TO: Step 5 ⇒ page 195 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 195 .

Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.23 Motronic Engine Control Module Power Supply Relay - J271- , Checking

General Description

The following procedure is used to diagnose the Motronic Engine Control Module Power Supply Relay - J271- and the Engine Control Module - J623- power supply voltage that is provided by the Motronic Engine Control Module Power Supply Relay - J271- .

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Manual Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Observe all safety precautions: ⇒ "1.1 Safety Precautions", page 2 .
- View clean working conditions: ⇒ "1.2 Clean Working Conditions", page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ "3.1 Preliminary Check", page 13 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 196 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Motronic Engine Control Module Power Supply Relay - J271- from the SB Fuse box in the engine compartment. • IGNITION: ON. • CHECK: Motronic Engine Control Module Power Supply Relay - J271- socket terminals 30 and 85 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Were Values obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 196 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 6 ⇒ page 197 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CONNECT: Jumper wire, Motronic Engine Control Module Power Supply Relay - J271- socket terminals 30 and 87. • IGNITION: ON. • CHECK: Engine Control Module - J623- harness connector T94 / 3, T94 / 5 and T94 / 6 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Were Values obtained?	– YES: ♦ GO TO: Step 4 ⇒ page 196 . – NO: ♦ GO TO: Step 5 ⇒ page 197 .
4	• DISCONNECT: Jumper wire, Motronic Engine Control Module Power Supply Relay - J271- socket terminals 30 and 87. • CHECK: Motronic Engine Control Module Power Supply Relay - J271- socket terminal 86 to the Engine Control Module - J623- harness connector T94 / 69 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ♦ REPLACE: Motronic Engine Control Module Power Supply Relay - J271- . Refer to appropriate repair manual. ♦ GO TO: Step 6 ⇒ page 197 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 6 ⇒ page 197 .

Step	Procedure	Result / Action to Take
5	• DISCONNECT: Jumper wire, Motronic Engine Control Module Power Supply Relay - J271- socket terminals 30 and 87. • REMOVE: Appropriate fuse On Fuse Panel B (refer to appropriate wiring diagram). • CHECK: Downstream (output) side of appropriate fuse On Fuse Panel B to the Engine Control Module - J623- harness connector T94 / 3, T94 / 5 and T94 / 6 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ REPLACE: Fuse Panel B - SB- fuse box. Refer to appropriate repair manual. ◆ GO TO: Step 6 ⇒ page 197 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 6 ⇒ page 197 .
6	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC's. ◆ If no DTC's return the repair is complete. ◆ Return vehicle to customer.

3.6.24 Oxygen Sensor 1 After Catalytic Converter - GX7- , Checking

General Description

The Oxygen Sensor 1 After Catalytic Converter - GX7- downstream of the primary catalytic converter supplies the Engine Control Module - J623- with a voltage signal (nonlinear) indicating "rich" or "lean. If the primary catalytic converter is supersaturated with oxygen (lean mixture), Oxygen Sensor 1 After Catalytic Converter - GX7- will send the Engine Control Module - J623- a nonlinear signal indicating the lean mixture condition. The mixture is then enriched with fuel until the oxygen has been "displaced" from the catalytic converter. This condition, in turn, is registered by Oxygen Sensor 1 After Catalytic Converter - GX7- as a nonlinear signal indicating the rich mixture condition. The mixture is then leaned out by the Engine Control Module - J623- . If the nonlinear signal is received again, the mixture will again be enriched. The frequency, or period, during which the mixture is enriched or leaned out is variable, being dependent on the gas flow rate (engine load) at that moment.

Note the Oxygen Sensor 1 After Catalytic Converter - GX7- is also referred to as the Oxygen Sensor After Three Way Catalytic Converter - G130- .

The Oxygen Sensor 1 After Catalytic Converter - GX7- contains the following components:

- Oxygen Sensor After Three Way Catalytic Converter - G130-
- Heater For Oxygen Sensor 1 After Catalytic Converter - Z29-

The Oxygen Sensor 1 After Catalytic Converter - GX7- components cannot be serviced separately, it must be serviced as a unit.

Special tools and workshop equipment required

- Multimeter.
- Wiring Diagram.
- Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions:
⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to Oxygen Sensor Preliminary Tests in ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 198 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Oxygen Sensor 1 After Catalytic Converter - GX7- harness connector. • CHECK: Oxygen Sensor 1 After Catalytic Converter - GX7- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 1 – 5 Ω (@ 25° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 199 . – NO: ♦ REPLACE: Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to appropriate repair manual. ♦ GO TO: Step 6 ⇒ page 200 .

Step	Procedure	Result / Action to Take
3	• IGNITION: ON. • CHECK: Oxygen Sensor 1 After Catalytic Converter - GX7- harness connector terminal 1 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 199 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 6 ⇒ page 200 .
4	• RECONNECT: Oxygen Sensor 1 After Catalytic Converter - GX7- harness connector. • CONNECT: Scan Tool. • START: Engine and let Idle. • Perform the function test located in Diagnostic Mode 06. Refer to appropriate Diagnostic Mode 06 - Read Test Results for Specific Diagnostic Functions, ⇒ “3.3 Diagnostic Modes 01 - 09”, page 16 . • SPECIFIED VALUE: Mode 6 Pass. • IGNITION: OFF. – Were Values obtained?	– YES: ◆ FAULT: Is intermittent. ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 6 ⇒ page 200 . – NO: ◆ GO TO: Step 5 ⇒ page 199 .
5	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Oxygen Sensor 1 After Catalytic Converter - GX7- harness connector terminal 2 to the Engine Control Module - J623- harness connector T94 / 54 for resistance. • CHECK: Oxygen Sensor 1 After Catalytic Converter - GX7- harness connector terminal 3 to the Engine Control Module - J623- harness connector T94 / 33 for resistance. • CHECK: Oxygen Sensor 1 After Catalytic Converter - GX7- harness connector terminal 4 to the Engine Control Module - J623- harness connector T94 / 84 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ REPLACE: Oxygen Sensor 1 After Catalytic Converter - GX7- . Refer to appropriate repair manual. ◆ GO TO: Step 6 ⇒ page 200 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 6 ⇒ page 200 .

Step	Procedure	Result / Action to Take
6	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.25 Oxygen Sensor 1 Before Catalytic Converter - GX10- , Checking

General Description

The Oxygen Sensor 1 Before Catalytic Converter - GX10- does not actually measure oxygen concentration, but rather the difference between the amount of oxygen in the exhaust gas and the amount of oxygen in air. Rich mixture causes an oxygen demand. This demand causes a voltage to build up, due to transportation of oxygen ions through the Oxygen Sensor 1 Before Catalytic Converter - GX10- layer. Lean mixture causes low voltage, since there is an oxygen excess. The Oxygen Sensor 1 Before Catalytic Converter - GX10- and catalytic converters are used in order to reduce exhaust emissions. Information on oxygen concentration is sent to Engine Control Module - J623- , which adjusts the amount of fuel injected into the engine to compensate for excess air or excess fuel. The Engine Control Module - J623- attempts to maintain, on average, a certain air–fuel ratio by interpreting the information it gains from the Heated Oxygen Sensor - G39- . The primary goal is a compromise between power, fuel economy, and emissions. The heater for Oxygen Sensor 1 Before Catalytic Converter - GX10- is designed to minimize the time-to-readiness for closed-loop operation by heating the Oxygen Sensor 1 Before Catalytic Converter - GX10- as quickly as possible.

Note the Oxygen Sensor 1 Before Catalytic Converter - GX10- is also referred to as the Heated Oxygen Sensor - G39- .

The Oxygen Sensor 1 Before Catalytic Converter - GX10- contains the following components:

♦ Heated Oxygen Sensor - G39-

♦ Oxygen Sensor Heater - Z19-

The Oxygen Sensor 1 Before Catalytic Converter - GX10- components cannot be serviced separately, it must be serviced as a unit.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to Oxygen Sensor Preliminary Tests in ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 201 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Oxygen Sensor 1 Before Catalytic Converter - GX10- harness connector. • CHECK: Oxygen Sensor 1 Before Catalytic Converter - GX10- component connector terminals 3 to 4 for resistance. • SPECIFIED VALUE: 1 – 5 Ω (@ 25° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 201 . – NO: ♦ REPLACE: Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to appropriate repair manual. ♦ GO TO: Step 6 ⇒ page 203 .
3	• IGNITION: ON. • CHECK: Oxygen Sensor 1 Before Catalytic Converter - GX10- harness connector terminal 4 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ♦ GO TO: Step 4 ⇒ page 202 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 6 ⇒ page 203 .

Step	Procedure	Result / Action to Take
4	• RECONNECT: Oxygen Sensor 1 Before Catalytic Converter - GX10- harness connector. • CONNECT: Scan Tool. • START: Engine and let Idle. • Perform the function test located in Diagnostic Mode 06. Refer to appropriate Diagnostic Mode 06 - Read Test Results for Specific Diagnostic Functions, ⇒ “3.3 Diagnostic Modes 01 - 09”, page 16 . • SPECIFIED VALUE: Mode 6 Pass. • IGNITION: OFF. – Were Values obtained?	– YES: ♦ FAULT: Is intermittent. ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 6 ⇒ page 203 . – NO: ♦ GO TO: Step 5 ⇒ page 202 .
5	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Oxygen Sensor 1 Before Catalytic Converter - GX10- harness connector terminal 1 to the Engine Control Module - J623- harness connector T94 / 78 for resistance. • CHECK: Oxygen Sensor 1 Before Catalytic Converter - GX10- harness connector terminal 2 to the Engine Control Module - J623- harness connector T94 / 79 for resistance. • CHECK: Oxygen Sensor 1 Before Catalytic Converter - GX10- harness connector terminal 3 to the Engine Control Module - J623- harness connector T94 / 73 for resistance. • CHECK: Oxygen Sensor 1 Before Catalytic Converter - GX10- harness connector terminal 5 to the Engine Control Module - J623- harness connector T94 / 56 for resistance. • CHECK: Oxygen Sensor 1 Before Catalytic Converter - GX10- harness connector terminal 6 to the Engine Control Module - J623- harness connector T94 / 57 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ♦ REPLACE: Oxygen Sensor 1 Before Catalytic Converter - GX10- . Refer to appropriate repair manual. ♦ GO TO: Step 6 ⇒ page 203 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 6 ⇒ page 203 .

Step	Procedure	Result / Action to Take
6	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.26 Oxygen Sensor 2 Before Catalytic Converter - GX11- , Checking

General Description

The Oxygen Sensor 2 Before Catalytic Converter - GX11- does not actually measure oxygen concentration, but rather the difference between the amount of oxygen in the exhaust gas and the amount of oxygen in the air. Rich mixture causes an oxygen demand. This demand causes a voltage to build up, due to transportation of oxygen ions through the Oxygen Sensor 2 Before Catalytic Converter - GX11- layer. Lean mixture causes low voltage, since there is an oxygen excess. The Oxygen Sensor 2 Before Catalytic Converter - GX11- and catalytic converters are used in order to reduce exhaust emissions. Information on oxygen concentration is sent to Engine Control Module - J623- , which adjusts the amount of fuel injected into the engine to compensate for excess air or excess fuel. The Engine Control Module - J623- attempts to maintain, on average, a certain air–fuel ratio by interpreting the information it gains from the Oxygen Sensor 2 Before Catalytic Converter - GX11- . The primary goal is a compromise between power, fuel economy, and emissions. The heater for Oxygen Sensor 2 Before Catalytic Converter - GX11- is designed to minimize the time-to-readiness for closed-loop operation by heating the Oxygen Sensor 2 Before Catalytic Converter - GX11- as quickly as possible.

Note the Oxygen Sensor 2 Before Catalytic Converter - GX11- is also referred to as the Heated Oxygen Sensor 2 - G108- .

The Oxygen Sensor 2 Before Catalytic Converter - GX11- contains the following components:

♦ Oxygen Sensor 2 Heater - Z28-

♦ Heated Oxygen Sensor 2 - G108-

The Oxygen Sensor 2 Before Catalytic Converter - GX11- components cannot be serviced separately, it must be serviced as a unit.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to Oxygen Sensor Preliminary Tests in ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 204 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Oxygen Sensor 2 Before Catalytic Converter - GX11- harness connector. • CHECK: Oxygen Sensor 2 Before Catalytic Converter - GX11- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 1 – 5 Ω (@ 25° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 204 . – NO: ♦ REPLACE: Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to appropriate repair manual. ♦ GO TO: Step 6 ⇒ page 205 .
3	• IGNITION: ON. • CHECK: Oxygen Sensor 2 Before Catalytic Converter - GX11- harness connector terminal 1 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ♦ GO TO: Step 4 ⇒ page 205 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO: Step 6 ⇒ page 205 .

Step	Procedure	Result / Action to Take
4	• RECONNECT: Oxygen Sensor 2 Before Catalytic Converter - GX11- harness connector. • CONNECT: Scan Tool. • START: Engine and let Idle. • Perform the function test located in Diagnostic Mode 06. Refer to appropriate Diagnostic Mode 06 - Read Test Results for Specific Diagnostic Functions, ⇒ “3.3 Diagnostic Modes 01 - 09”, page 16 . • SPECIFIED VALUE: Mode 6 Pass. • IGNITION: OFF. – Were Values obtained?	– YES: ◆ FAULT: Is intermittent. ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 6 ⇒ page 205 . – NO: ◆ GO TO: Step 5 ⇒ page 205 .
5	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Oxygen Sensor 2 Before Catalytic Converter - GX11- harness connector terminal 2 to the Engine Control Module - J623- harness connector T94 / 29 for resistance. • CHECK: Oxygen Sensor 2 Before Catalytic Converter - GX11- harness connector terminal 3 to the Engine Control Module - J623- harness connector T94 / 34 for resistance. • CHECK: Oxygen Sensor 2 Before Catalytic Converter - GX11- harness connector terminal 4 to the Engine Control Module - J623- harness connector T94 / 62 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ REPLACE: Oxygen Sensor 2 Before Catalytic Converter - GX11- . Refer to appropriate repair manual. ◆ GO TO: Step 6 ⇒ page 205 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 6 ⇒ page 205 .
6	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Clear the DTC’s. Refer to ⇒ “3.3.4 Diagnostic Mode 04 - Erase DTC Memory”, page 21 . ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ “3.2 Readiness Code”, page 14 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC’s. ◆ If no DTC’s return the repair is complete. ◆ Return vehicle to customer.

3.6.27 Secondary Air Injection Pump Relay - J299- / Secondary Air Injection Pump Motor - V101- , Checking

General Description

The Engine Control Module - J623- closes the Secondary Air Injection Pump Relay - J299- in order for it to provide the power supply voltage to the Secondary Air Injection Pump Motor - V101- . The Engine Control Module - J623- cycles the relay (and the pump motor) on and off as necessary.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions:
⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 206 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Secondary Air Injection Pump Relay - J299- . Refer to appropriate repair manual. • IGNITION: ON. • CHECK: Secondary Air Injection Pump Relay - J299- socket terminals 85 and 30 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Were Values obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 207 . – NO: ♦ PERFORM: Visual Inspection of wiring and component. ♦ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ♦ REPAIR: Faulty wiring or connector. ♦ GO TO Step 7 ⇒ page 208 .

Step	Procedure	Result / Action to Take
3	• CONNECT: Jumper wire, Secondary Air Injection Pump Relay - J299- socket terminals 30 and 87. • IGNITION: ON. • IGNITION: OFF. • SPECIFIED VALUE: The Secondary Air Injection Pump Motor - -V101-- should be heard running. – Was Value obtained?	– YES: ◆ GO TO: Step 6 ⇒ page 207 . – NO: ◆ GO TO: Step 4 ⇒ page 207 .
4	• DISCONNECT: Secondary Air Injection Pump Motor - -V101-- harness connector. • IGNITION: ON. • CHECK: Secondary Air Injection Pump Motor - -V101-- harness connector terminal 2 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 207 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 208 .
5	• CHECK: Secondary Air Injection Pump Motor - -V101-- harness connector terminal 1 to ground for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ REPLACE: Secondary Air Injection Pump Motor - -V101-. Refer to appropriate repair manual. ◆ GO TO: Step 7 ⇒ page 208 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 208 .
6	• DISCONNECT: Jumper wire, Secondary Air Injection Pump Relay - J299- socket terminals 30 and 87. • REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Secondary Air Injection Pump Relay - J299- socket terminal 86 to the Engine Control Module - J623- harness connector T94 / 94 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ REPLACE: Secondary Air Injection Pump Relay - J299- . Refer to appropriate repair manual. ◆ GO TO: Step 7 ⇒ page 208 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 208 .

Step	Procedure	Result / Action to Take
7	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.28 Secondary Air Injection Sensor 1 - G609- , Checking

General Description

The secondary air injection system blows air into the exhaust on a cold-start of the engine for 45 – 100 seconds and serves to quickly heat the catalytic converter(s) for improved emissions. A pressure based secondary air diagnostic function is used. In this system, the signal from the Secondary Air Injection Sensor 1 - G609- is evaluated by the Engine Control Module - J623- .

Special tools and workshop equipment required

♦ Multimeter.

♦ Wiring Diagram.

♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Manual Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Observe all safety precautions: ⇒ "1.1 Safety Precautions", page 2 .
- View clean working conditions: ⇒ "1.2 Clean Working Conditions", page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 209 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Secondary Air Injection Sensor 1 - G609- harness connector. • IGNITION: ON. • CHECK: Secondary Air Injection Sensor 1 - G609- harness connector terminals 1 to 3 for voltage. • IGNITION: OFF. • SPECIFIED VALUE: About 5.0 V. – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 209 . – NO: ◆ GO TO: Step 4 ⇒ page 209 .
3	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Secondary Air Injection Sensor 1 - G609- harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / 52 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ REPLACE: Secondary Air Injection Sensor 1 - G609- . Refer to appropriate repair manual. ◆ GO TO: Step 5 ⇒ page 210 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 210 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Secondary Air Injection Sensor 1 - G609- harness connector terminal 1 to the Engine Control Module - J623- harness connector T60 / 29 for resistance. • CHECK: Secondary Air Injection Sensor 1 - G609- harness connector terminal 3 to the Engine Control Module - J623- harness connector T60 / 13 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 210 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 210 .

Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.29 Secondary Air Injection Solenoid Valve - N112- , Checking

General Description

The secondary air injection system blows air into the exhaust on a cold-start of the engine for 45 – 100 seconds and serves to quickly heat the catalytic converter(s) for improved emissions. A pressure based secondary air diagnostics function is used. In this system, the signal from the Secondary Air Injection Sensor 1 - G609- is evaluated in the Engine Control Module - J623- . The injected air quantity is determined from the pressure level by the Engine Control Module - J623- cycling the Secondary Air Injection Solenoid Valve - N112- open and closed.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Manual Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Observe all safety precautions: ⇒ "1.1 Safety Precautions", page 2 .

- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 211 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Secondary Air Injection Solenoid Valve - N112- harness connector. • CHECK: Secondary Air Injection Solenoid Valve - N112- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 5 – 35 Ω (at approx. 20° C). – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 211 . – NO: ◆ REPLACE: Secondary Air Injection Solenoid Valve - N112- . Refer to appropriate repair manual. ◆ GO TO: Step 5 ⇒ page 212 .
3	• IGNITION: ON. • CHECK: Secondary Air Injection Solenoid Valve - N112- harness connector terminal 1 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 211 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 212 .
4	• REMOVE: Engine Control Module - J623- Refer to appropriate repair manual. • CHECK: Secondary Air Injection Solenoid Valve - N112- harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / 60 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ REPLACE: Secondary Air Injection Solenoid Valve - N112- . Refer to appropriate repair manual. ◆ GO TO: Step 5 ⇒ page 212 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 212 .

Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.30 Three Way Catalytic Converter (TWC), Checking

General Description

A catalytic converter is a vehicle emissions control device that converts toxic pollutants in exhaust gas to less toxic pollutants by catalyzing a redox reaction (oxidation or reduction). Catalytic converters are used in internal combustion engines.

General recommendations

Oxygen sensors OK.

No leaks or damage to exhaust system.

Prior to repair work, perform a preliminary check to verify the condition. Refer to ⇒ "3.1 Preliminary Check", page 13 .

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Manual Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Observe all safety precautions: ⇒ "1.1 Safety Precautions", page 2 .
- View clean working conditions: ⇒ "1.2 Clean Working Conditions", page 3 .

Function test

Step	Procedure	Result / Action to Take
1	Activate Monitors: • Perform the function test in Diagnostic Mode 06. Refer to appropriate Diagnostic Mode 06 - Read Test Results for Specific Diagnostic Functions, ⇒ “3.3 Diagnostic Modes 01 - 09”, page 16 . • End diagnosis and switch the ignition off. • If the specified values are exceeded:	♦ Check the exhaust system for leaks. ♦ If necessary, repair the leak(s) in the exhaust system. ♦ GO TO: Step 2 ⇒ page 213 .
2	O2 Sensor Monitoring: • Erase the DTC memory. Refer to ⇒ “3.3.4 Diagnostic Mode 04 - Erase DTC Memory”, page 21 . • Perform a road test to verify Repair. • If the DTC does not return:	♦ Generate readiness code. Refer to ⇒ “3.2 Readiness Code”, page 14 . ♦ If no leaks are found in the exhaust system: ♦ Replace the catalytic converter with front exhaust pipe. Refer to appropriate repair manual. ♦ GO TO: Step 3 ⇒ page 213 .
3	• Final procedure: • Perform a road test to verify repair.	• After the repair work, the following work steps must be performed in the following sequence: • Check the DTC memory. Refer to ⇒ “3.3.3 Diagnostic Mode 03 - Read DTC Memory”, page 20 . • If necessary, erase the DTC memory. Refer to ⇒ “3.3.4 Diagnostic Mode 04 - Erase DTC Memory”, page 21 . • If the DTC memory was erased, generate readiness code. Refer to ⇒ “3.2 Readiness Code”, page 14 . • Return vehicle to Customer.

3.6.31 Throttle Valve Control Module - GX3- , Checking

General Description

Throttle valve operation occurs by an electric motor identified as EPC Throttle Drive - G186- located within the Throttle Valve Control Module - GX3- . It is controlled by the Engine Control Module - J623- with primary inputs from the Accelerator Pedal Module - GX2- as well as other peripheral inputs from EPC Throttle Drive Angle Sensor 1 - G187- and EPC Throttle Drive Angle Sensor 2 - G188- .

The Throttle Valve Control Module - GX3- contains the following components:

- ♦ Throttle Valve Control Module - J338-
- ♦ EPC Throttle Drive - G186-
- ♦ EPC Throttle Drive Angle Sensor 1 - G187-
- ♦ EPC Throttle Drive Angle Sensor 2 - G188-

The Throttle Valve Control Module - GX3- components cannot be serviced separately, and must be serviced as a unit.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions:
  ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions:
  ⇒ “1.2 Clean Working Conditions”, page 3 .

Test procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 214 . – NO: ♦ GATHER more information from customer about the complaint.
2	• CONNECT: Scan Tool. • IGNITION: ON. • CHECK: Throttle valve position closed. • SPECIFIED VALUE: 3 - 25%. • DEPRESS: Accelerator pedal slowly to WOT while observing the percentage display. The percentage display must increase uniformly. • CHECK: Throttle valve position at WOT. • IGNITION: OFF. • SPECIFIED VALUE: 84 – 97%. – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 214 . – NO: ♦ GO TO: Step 4 ⇒ page 215 .
3	• Condition may be intermittent • PERFORM: Visual Inspection of wiring and component • CHECK: Wiring for open, high resistance, short or electrical connector for damage, corrosion, loose or broken terminals • REPAIR: Faulty wiring or connector	♦ GO TO: Step 7 ⇒ page 216 .

Step	Procedure	Result / Action to Take
4	• REMOVE: Throttle Valve Control Module - GX3- far enough so that the harness connector terminals are accessible. • DISCONNECT: Throttle Valve Control Module - GX3- harness connector. • IGNITION: ON. • CHECK: Throttle Valve Control Module - GX3- harness connector pins 2 to 6 for voltage. • CHECK: Throttle Valve Control Module - GX3- harness connector pin 2 to ground for voltage. • SPECIFIED VALUE: About 5.0 V. • IGNITION: OFF. – Were Values obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 215 . – NO: ◆ GO TO: Step 6 ⇒ page 215 .
5	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Throttle Valve Control Module - GX3- harness connector terminal 1 to the Engine Control Module - J623- harness connector T60 / 41 for resistance. • CHECK: Throttle Valve Control Module - GX3- harness connector terminal 3 to the Engine Control Module - J623- harness connector T60 / 17 for resistance. • CHECK: Throttle Valve Control Module - GX3- harness connector terminal 4 to the Engine Control Module - J623- harness connector T60 / 44 for resistance. • CHECK: Throttle Valve Control Module - GX3- harness connector terminal 5 to the Engine Control Module - J623- harness connector T60 / 16 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ REPLACE: Throttle Valve Control Module - GX3- . Refer to appropriate repair manual. ◆ GO TO: Step 7 ⇒ page 216 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 216 .
6	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Throttle Valve Control Module - GX3- harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / 12 for resistance. • CHECK: Throttle Valve Control Module - GX3- harness connector terminal 6 to the Engine Control Module - J623- harness connector T60 / 24 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Were Values obtained?	– YES: ◆ GO TO: Step 7 ⇒ page 216 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 7 ⇒ page 216 .

Step	Procedure	Result / Action to Take
7	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.32 Turbocharger Recirculation Valve - N249-, Checking

General Description

A Turbocharger Recirculation Valve - N249- keeps a portion of air running through the intake side of the turbocharger when the throttle valve is closed and boost pressure is still present. This keeps the turbocharger impeller from slowing down, reducing turbo lag when the throttle is applied again.

Special tools and workshop equipment required

♦ Multimeter.

♦ Wiring Diagram.

♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Manual Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Observe all safety precautions:
  ⇒ "1.1 Safety Precautions", page 2 .
- View clean working conditions:
  ⇒ "1.2 Clean Working Conditions", page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ "3.1 Preliminary Check", page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 217 . – NO: ◆ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Turbocharger Recirculation Valve - N249- harness connector. • CHECK: Turbocharger Recirculation Valve - N249- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 3 – 15 Ω (at approx. 20° C). – Was Value obtained?	– YES: ◆ GO TO: Step 3 ⇒ page 217 . – NO: ◆ REPLACE: Turbocharger Recirculation Valve - N249- . Refer to appropriate repair manual. ◆ GO TO: Step 5 ⇒ page 218 .
3	• IGNITION: ON. • CHECK: Turbocharger Recirculation Valve - N249- harness connector terminal 1 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 217 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 218 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Turbocharger Recirculation Valve - N249- harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / 50 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 218 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 218 .

Step	Procedure	Result / Action to Take
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ♦ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ♦ REPAIR: As necessary. ♦ If all electrical connections are OK: ♦ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ♦ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ♦ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ♦ Return vehicle to Customer. – NO: ♦ Perform the diagnostic procedure for any DTC's. ♦ If no DTC's return the repair is complete. ♦ Return vehicle to customer.

3.6.33 Vehicle Speed Signal, Checking

General Description

The Vehicle Speed Signal or VSS measures Transmission / Transaxle output or Wheel Speed from the ABS System. The signal is broadcasted over the CAN Bus. The Engine Control Module - J623- uses this information to modify engine functions such as ignition timing, A/F ratio, transmission shift points, and to initiate diagnostic routines.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in "P".
- Vehicles with Manual Transmission, ensure Shifter Lever position is in "N" with Parking Brake applied.
- Observe all safety precautions: ⇒ "1.1 Safety Precautions", page 2 .
- View clean working conditions: ⇒ "1.2 Clean Working Conditions", page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ◆ GO TO: Step 2 ⇒ page 219 . – NO: ◆ GATHER more information from customer about the complaint.
2	• CONNECT: Scan Tool. • ROAD TEST: Vehicle. • CHECK: Scan Tool to Speedometer for accuracy. • SPECIFIED VALUE: Difference ≤ 10%. – Was Value obtained?	– YES: ◆ CONDITION: May be intermittent. ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 4 ⇒ page 219 . – NO: ◆ GO TO: Step 3 ⇒ page 219 .
3	• CHECK: ABS system. • CHECK: ABS DTC’s. – Was the ABS system OK?	– YES: ◆ CHECK: CAN Bus wiring from Instrument Cluster Control Module - J285- to ABS Control Module - J104- . ◆ GO TO: Step 4 ⇒ page 219 . – NO: ◆ REPAIR: Any ABS concerns 1st. ◆ GO TO: Step 4 ⇒ page 219 .
4	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Clear the DTC’s. Refer to ⇒ “3.3.4 Diagnostic Mode 04 - Erase DTC Memory”, page 21 . ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ “3.2 Readiness Code”, page 14 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC’s. ◆ If no DTC’s return the repair is complete. ◆ Return vehicle to customer.

3.6.34 Wastegate Bypass Regulator Valve - N75- , Checking

General Description

Both the boost and intake pressures are used to control the wastegate of the turbocharger. These pressure signals are supplied to the Engine Control Module - J623- , which then sends a pulse-width modulated signal to the Wastegate Bypass Regulator Valve - N75- . As a result, the Wastegate Bypass Regulator Valve - N75- controls vacuum supply to the Pressure Unit, which directly acts on the wastegate via a connecting rod. This control system regulates the turbine speed and sets the maximum boost pressure.

Special tools and workshop equipment required

- ♦ Multimeter.
- ♦ Wiring Diagram.
- ♦ Scan Tool.

Test requirements

- Fuses OK.
- Battery voltage OK.
- Switch OFF All electrical and electronic accessories.
- Vehicles with Auto. Transmission, ensure Selector Lever position is in “P”.
- Vehicles with Manual Transmission, ensure Shifter Lever position is in “N” with Parking Brake applied.
- Observe all safety precautions: ⇒ “1.1 Safety Precautions”, page 2 .
- View clean working conditions: ⇒ “1.2 Clean Working Conditions”, page 3 .

Test Procedure

Step	Procedure	Result / Action to Take
1	• PERFORM: Preliminary Check to verify the customers complaint. Refer to ⇒ “3.1 Preliminary Check”, page 13 . – Was Complaint verified?	– YES: ♦ GO TO: Step 2 ⇒ page 220 . – NO: ♦ GATHER more information from customer about the complaint.
2	• IGNITION: OFF. • DISCONNECT: Wastegate Bypass Regulator Valve - N75- harness connector. • CHECK: Wastegate Bypass Regulator Valve - N75- component connector terminals 1 to 2 for resistance. • SPECIFIED VALUE: 5 – 25 Ω (at approx. 20° C). – Was Value obtained?	– YES: ♦ GO TO: Step 3 ⇒ page 221 . – NO: ♦ REPLACE: Wastegate Bypass Regulator Valve - N75- . Refer to appropriate repair manual. ♦ GO TO: Step 5 ⇒ page 221 .

Step	Procedure	Result / Action to Take
3	• IGNITION: ON. • CHECK: Wastegate Bypass Regulator Valve - N75- harness connector terminal 1 to ground for voltage. • IGNITION: OFF. • SPECIFIED VALUE: Battery voltage. – Was Value obtained?	– YES: ◆ GO TO: Step 4 ⇒ page 221 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 221 .
4	• REMOVE: Engine Control Module - J623- . Refer to appropriate repair manual. • CHECK: Wastegate Bypass Regulator Valve - N75- harness connector terminal 2 to the Engine Control Module - J623- harness connector T60 / 3 for resistance. • SPECIFIED VALUE: 0.5 Ω (± 0.3 Ω). – Was Value obtained?	– YES: ◆ GO TO: Step 5 ⇒ page 221 . – NO: ◆ PERFORM: Visual Inspection of wiring and component. ◆ CHECK: Wiring for open, high resistance, short or harness connector for damage, corrosion, loose or broken terminals. ◆ REPAIR: Faulty wiring or connector. ◆ GO TO: Step 5 ⇒ page 221 .
5	• Final Procedure • Perform a road test to verify repair. – Does the original DTC return?	– YES: ◆ CHECK: Engine Control Module - J623- harness connector for any damaged, pushed-out pins. ◆ REPAIR: As necessary. ◆ If all electrical connections are OK: ◆ REPLACE: Engine Control Module - J623- . Refer to appropriate repair manual. ◆ Clear the DTC's. Refer to ⇒ "3.3.4 Diagnostic Mode 04 - Erase DTC Memory", page 21 . ◆ Repair is complete. Generate Readiness Code. Refer to ⇒ "3.2 Readiness Code", page 14 . ◆ Return vehicle to Customer. – NO: ◆ Perform the diagnostic procedure for any DTC's. ◆ If no DTC's return the repair is complete. ◆ Return vehicle to customer.

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Cautions & Warnings

Please read these WARNINGS and CAUTIONS before proceeding with maintenance and repair work. You must answer that you have read and you understand these WARNINGS and CAUTIONS before you will be allowed to view this information.

- If you lack the skills, tools and equipment, or a suitable workshop for any procedure described in this manual, we suggest you leave such repairs to an authorized Volkswagen retailer or other qualified shop. We especially urge you to consult an authorized Volkswagen retailer before beginning repairs on any vehicle that may still be covered wholly or in part by any of the extensive warranties issued by Volkswagen.

- Disconnect the battery negative terminal (ground strap) whenever you work on the fuel system or the electrical system. Do not smoke or work near heaters or other fire hazards. Keep an approved fire extinguisher handy.

- Volkswagen is constantly improving its vehicles and sometimes these changes, both in parts and specifications, are made applicable to earlier models. Therefore, part numbers listed in this manual are for reference only. Always check with your authorized Volkswagen retailer parts department for the latest information.

- Any time the battery has been disconnected on an automatic transmission vehicle, it will be necessary to reestablish Transmission Control Module (TCM) basic settings using the VAG 1551 Scan Tool (ST).

- Never work under a lifted vehicle unless it is solidly supported on stands designed for the purpose. Do not support a vehicle on cinder blocks, hollow tiles or other props that may crumble under continuous load. Never work under a vehicle that is supported solely by a jack. Never work under the vehicle while the engine is running.

- For vehicles equipped with an anti-theft radio, be sure of the correct radio activation code before disconnecting the battery or removing the radio. If the wrong code is entered when the power is restored, the radio may lock up and become inoperable, even if the correct code is used in a later attempt.

- If you are going to work under a vehicle on the ground, make sure that the ground is level. Block the wheels to keep the vehicle from rolling. Disconnect the battery negative terminal (ground strap) to prevent others from starting the vehicle while you are under it.

- Do not attempt to work on your vehicle if you do not feel well. You increase the danger of injury to yourself and others if you are tired, upset or have taken medicine or any other substances that may impair you or keep you from being fully alert.

- Never run the engine unless the work area is well ventilated. Carbon monoxide (CO) kills.

- Always observe good workshop practices. Wear goggles when you operate machine tools or work with acid. Wear goggles, gloves and other protective clothing whenever the job requires working with harmful substances.

- Tie long hair behind your head. Do not wear a necktie, a scarf, loose clothing, or a necklace when you work near machine tools or running engines. If your hair, clothing, or jewelry were to get caught in the machinery, severe injury could result.

- Do not re-use any fasteners that are worn or deformed in normal use. Some fasteners are designed to be used only once and are unreliable and may fail if used a second time. This includes, but is not limited to, nuts, bolts, washers, circlips and cotter pins. Always follow the recommendations in this manual - replace these fasteners with new parts where indicated, and any other time it is deemed necessary by inspection.

next

Version 1.0

Cautions & Warnings

- Illuminate the work area adequately but safely. Use a portable safety light for working inside or under the vehicle. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

- Friction materials such as brake pads and clutch discs may contain asbestos fibers. Do not create dust by grinding, sanding, or by cleaning with compressed air. Avoid breathing asbestos fibers and asbestos dust. Breathing asbestos can cause serious diseases such as asbestosis or cancer, and may result in death.

- Finger rings should be removed so that they cannot cause electrical shorts, get caught in running machinery, or be crushed by heavy parts.

- Before starting a job, make certain that you have all the necessary tools and parts on hand. Read all the instructions thoroughly; do not attempt shortcuts. Use tools that are appropriate to the work and use only replacement parts meeting Volkswagen specifications. Makeshift tools, parts and procedures will not make good repairs.

- Catch draining fuel, oil or brake fluid in suitable containers. Do not use empty food or beverage containers that might mislead someone into drinking from them. Store flammable fluids away from fire hazards. Wipe up spills at once, but do not store the oily rags, which can ignite and burn spontaneously.

- Use pneumatic and electric tools only to loosen threaded parts and fasteners. Never use these tools to tighten fasteners, especially on light alloy parts. Always use a torque wrench to tighten fasteners to the tightening torque listed.

- Keep sparks, lighted matches, and open flame away from the top of the battery. If escaping hydrogen gas is ignited, it will ignite gas trapped in the cells and cause the battery to explode.

- Be mindful of the environment and ecology. Before you drain the crankcase, find out the proper way to dispose of the oil. Do not pour oil onto the ground, down a drain, or into a stream, pond, or lake. Consult local ordinances that govern the disposal of wastes.

- The air-conditioning (A/C) system is filled with a chemical refrigerant that is hazardous. The A/C system should be serviced only by trained automotive service technicians using approved refrigerant recovery/recycling equipment, trained in related safety precautions, and familiar with regulations governing the discharging and disposal of automotive chemical refrigerants.

- Before doing any electrical welding on vehicles equipped with anti-lock brakes (ABS), disconnect the battery negative terminal (ground strap) and the ABS control module connector.

- Do not expose any part of the A/C system to high temperatures such as open flame. Excessive heat will increase system pressure and may cause the system to burst.

- When boost-charging the battery, first remove the fuses for the Engine Control Module (ECM), the Transmission Control Module (TCM), the ABS control module, and the trip computer. In cases where one or more of these components is not separately fused, disconnect the control module connector(s).

- Some of the vehicles covered by this manual are equipped with a supplemental restraint system (SRS), that automatically deploys an airbag in the event of a frontal impact. The airbag is operated by an explosive device. Handled improperly or without adequate safeguards, it can be accidentally activated and cause serious personal injury. To guard against personal injury or airbag system failure, only trained Volkswagen Service technicians should test, disassemble or service the airbag system.

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Cautions & Warnings

- Do not quick-charge the battery (for boost starting) for longer than one minute, and do not exceed 16.5 volts at the battery with the boosting cables attached. Wait at least one minute before boosting the battery a second time.

- Never use a test light to conduct electrical tests of the airbag system. The system must only be tested by trained Volkswagen Service technicians using the VAG 1551 Scan Tool (ST) or an approved equivalent. The airbag unit must never be electrically tested while it is not installed in the vehicle.

- Some aerosol tire inflators are highly flammable. Be extremely cautious when repairing a tire that may have been inflated using an aerosol tire inflator. Keep sparks, open flame or other sources of ignition away from the tire repair area. Inflate and deflate the tire at least four times before breaking the bead from the rim. Completely remove the tire from the rim before attempting any repair.

- When driving or riding in an airbag-equipped vehicle, never hold test equipment in your hands or lap while the vehicle is in motion. Objects between you and the airbag can increase the risk of injury in an accident.

I have read and I understand these Cautions and Warnings.

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